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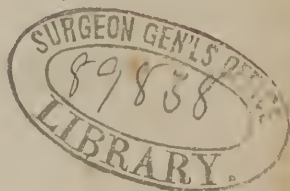
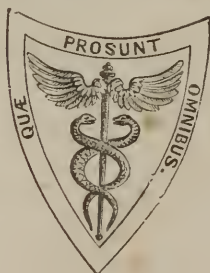
OF

S U R G E R Y.

BY

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EDINBURGH, SURGEON TO THE ROYAL
INFIRMARY, &c. &c.



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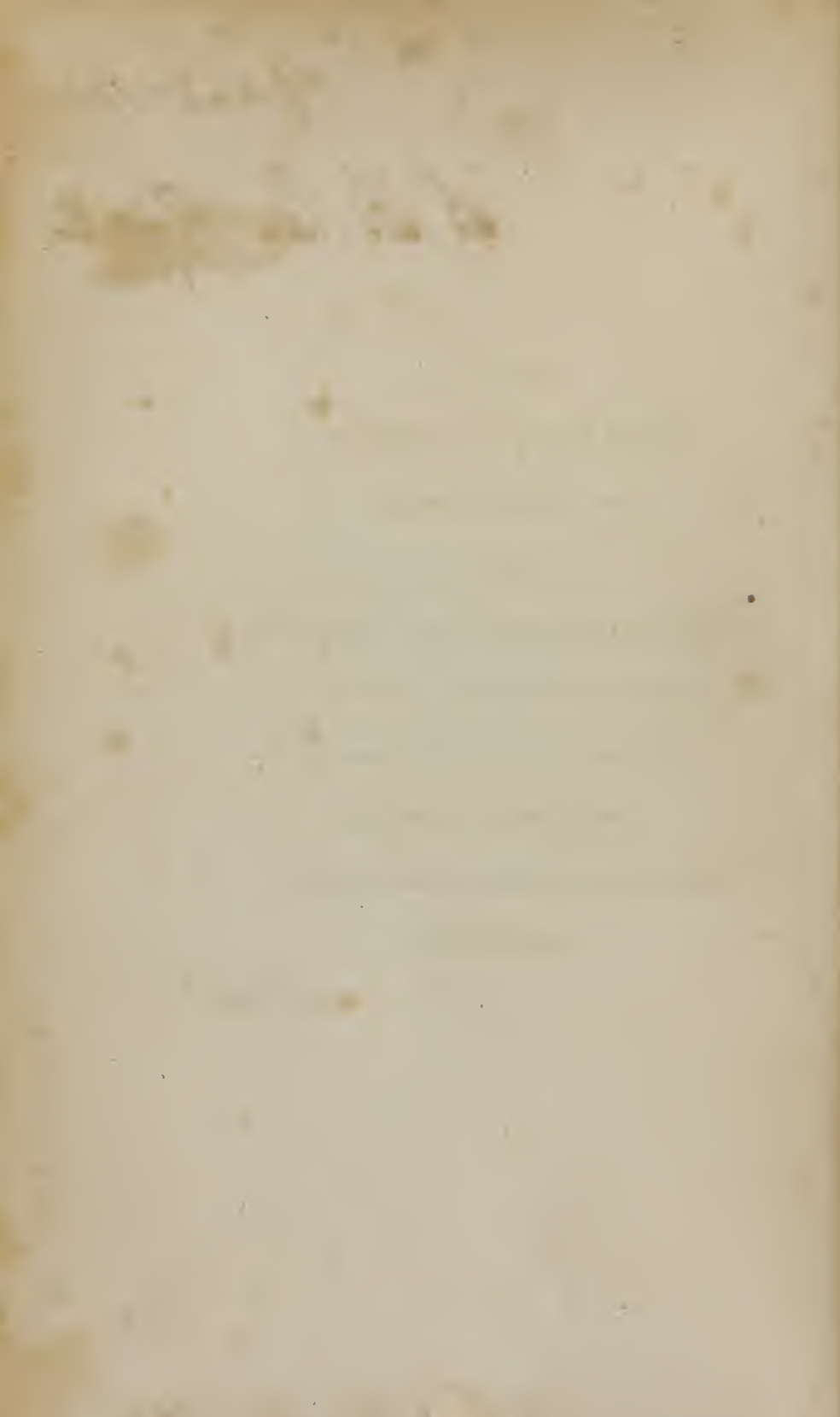
AND IN GRATEFUL ACKNOWLEDGMENT

OF MUCH PERSONAL KINDNESS,

AS WELL AS PROFESSIONAL INSTRUCTION,

CONFERRED ON

THE AUTHOR.



P R E F A C E.

THE following pages, intended to exhibit a condensed view of the Principles of the Healing Art, contain the substance of the Author's systematic Lectures on this subject. In their preparation, it has been his aim to combine, with soundness of doctrine, such simplicity of arrangement, and plainness of illustration, as seem best calculated to facilitate, while they direct, the labours of the Student.

To his own Pupils, the Volume is offered as one of reference, as well as a text-book ; and he ventures to hope, that, to others also, it may prove of service, as a concise exposition of the Science of Modern Surgery.

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SURGERY.

HISTORICAL NOTICE.*

THE term *Surgery*, or *Chirurgery*, from *χειρ*, the *hand*, and *εργον*, *work*, originally signified, as its derivation implies, the manual procedure, by means of instruments or otherwise, directed towards the repair of injury and the cure of disease; in contradistinction to the practice of *medicine*, which denotes the treatment of disease by the administration of drugs, or other substances supposed to be of a sanative tendency. Such a meagre description applied but too justly to surgery in its infancy, and still more after its separation from its twin-sister medicine, in the twelfth century. When its practice was denounced by the Council of Tours as derogatory to the dignity of the sacred office of the priesthood, and beneath the attention of all men of learning, the term *chirurgery*, in its most literal interpretation, was quite sufficient to comprehend the duties of the degraded and uninformed surgeon, who had degenerated into a mere mechanic, attached to, and completely dependent on, the learned and philosophic physician. But the matured progress of the healing art, fortunately for science and humanity, has rendered such a definition of surgery in these days utterly untenable. Its complete separation from medicine would not be attended with the utmost difficulty; nor is it desirable that the attempt should be made, because its success, however partial and imperfect, would be most hurtful to both. They are now, and it is to be hoped will ever remain, one and inseparable. Their principles are the same throughout, and the exercise of their different branches requires the same fundamental knowledge; but their details are so numerous and intricate as to render it most difficult, if not impossible, for any one individual to cultivate all with equal success. The consequence has been, that while the theory and principles of physic and surgery remain united, as constituting one and the same science, the practical parts are now frequently separated into distinct professions, each person adopting that department most congenial to his pursuits, and for the management of which he conceives himself best qualified. The separation, however, is not one of acquirements, but merely of practice. It should never be forgotten, that the physician, before he can be either accomplished or successful in his profession, must be intimately conversant with the principles, if not

* This condensed view of the History of Surgery was written by the Author for the last edition of the Encyclopædia Britannica, and is here reprinted by the kind permission of the Proprietors.

with the practice of surgery. And most certainly, no one can ever lay just claim even to the title of surgeon, far less hope for eminence or success, unless he be equally qualified to assume both the appellation and the employment of the physician.

Many and laboured have been the attempts to define surgery according to its present state, so as to prevent interference with the department of physic. This example we will not follow. The arrangement as to what is medical, and what surgical, must, in a great measure, depend on custom, not on fixed and permanent rules. The paths of the practical surgeon and physician are distinct, but in their course they must often cross each other; and these collisions, so far from being avoided, ought rather to be sought, as probable sources of mutual benefit, so long as those enlightened feelings are entertained, and that honourable conduct pursued, which ought ever to distinguish the followers of a liberal, useful, and learned profession.

That surgery is as old as man himself, that it was coeval with his fallen state, there can be little doubt. The fall entailed the frequent reception of injuries by external violence; and to assuage their pain and remove their inconvenience, the ingenuity and contrivance of the sufferer were, doubtless, powerfully excited. Thus it would seem that, as to antiquity of origin, surgery must take precedence of medicine. And after wars and dissensions began to prevail, and wounds and injuries became both more frequent and more deadly, it is most probable that to these the practitioners of the healing art alone directed their attention, before the nature of disease began to be understood, or its cure was supposed to be within the reach of human means.

As to the state of surgery among the early Egyptians, we know but little, except that it was customary, in the time of Joseph, to embalm the dead—a process which appertains closely to both medicine and surgery. There are some grounds, however, for suspecting that they were more conversant with surgery than is generally supposed; for it is said that on “the ruined walls of the renowned temples of ancient Thebes, basso-relievos have been found, displaying surgical operations, and instruments not far different from some in use in modern times.” Their medical practice, entirely founded on incantation and astrology, was sufficiently simple. They divided the body into thirty-six parts, believing in an equal number of demons, to whom those parts were intrusted, and to invoke whose aid in sickness was the principal duty of the physician, each spirit being called upon to cure his own peculiar portion.

Among the Jews, the operation of circumcision was performed, no doubt skilfully and dexterously, though with rude implements, by the priesthood, an order which, for many ages, and in many climes, conjoined the cure of the body with that of the soul.

The earliest notice of our art is from the ancient Greeks, who, it is probable, had derived their medical traditions from the Egyptians. They considered medicine to be of Divine origin; and its first professors, as they inform us, were no less personages than gods and sons of gods.

Medicine and surgery, at their origin, were conjoined; and both

continued to be practised indiscriminately, until separated by the Arabian school. Their complete estrangement occurred, as we have already stated, about the middle of the twelfth century. At first, surgery chiefly occupied the attention of the ancient leech, as the more certain and more obviously useful branch of his profession; but ultimately it became very secondary to medicine when dignified by philosophy and priestcraft.

Chiron the Centaur, born in Thessaly, is presumed to have been the father of surgery, celebrated for skilfully applying soothing herbs to wounds and bruises. But his fame is somewhat endangered by that of *Æsculapius*, the son of *Apollo*, by some held to be the pupil of Chiron, by others, his predecessor and superior. *Æsculapius* is supposed to have been deified, on account of his skill, about fifty years before the Trojan war. His very existence, however, has been questioned. *Apollo* was the original god of physic among the early Greeks; but he appears to have resigned in favour of *Æsculapius*, whose temples became the depositories of medical and surgical knowledge; more particularly those of *Epidaurus*, *Cnidos*, *Cos*, and *Pergamus*.

Certain it is, according to the testimony of *Celsus*, that *Æsculapius* is the most ancient authority in surgery. His immediate descendants, two sons, *Podalirius* and *Machaon*, have been immortalized by *Homer*. They followed *Agamemnon* to the Trojan war (B. C. 1192,) and there their services were so highly valued as to secure them a not unobtrusive niche among the heroes of the *Iliad*. Of the two, *Machaon* seems to have been the more distinguished. When he is wounded by *Paris*, the whole army is represented as interested in his recovery. Even the stern *Achilles* inquires anxiously after "the wounded offspring of the healing god;" and the valiant *Nestor*, to whose care he is intrusted, is exhorted to unwonted exertion in his behalf; "for a leech who, like him, knows how to cut out darts, and relieve the smarting of wounds by soothing unguents, is to armies more in value than many other heroes." *Podalirius* enjoys the distinction of being reputed the first of phlebotomists, and probably the most successful, from his time to this; having opened a vein in either arm of the King of *Caria's* daughter, who had been severely injured by a fall from the house-top; having, after her recovery, been rewarded with the hand of the fair princess; and having been presented by her munificent father with the *Chersonese* as her dowry. As to medicine, they seem to have been either ignorant, or in no great repute; for, on the breaking out of pestilence in the Grecian camp, *Homer* neglects them entirely, and applies at once to *Apollo*. And even their surgical attainments, for which they are celebrated by him, seem to have extended no farther than to the simple extraction of darts and other offensive weapons, the checking of hemorrhage by styptics or pressure, and the application of lenitive salves. The poet takes notice of his warriors sustaining fracture of the bones; but in such emergencies he adopts the same course as in the pestilence, and invokes the aid of the non-professional deities; from which circumstance we may infer, that in those days surgery had made but little advancement.

For upwards of 600 years after the Trojan war, there are scarcely

any accounts of medicine and surgery. They seem to have remained strangely stationary during the whole of that period. Their practice was confined to the Asclepiades, or reputed descendants of *Æsculapius*; whose lore was orally communicated from father to son in that family, until they received an extraordinary impulse from the great *Hippocrates*, himself a branch of the family, and said to have been the fifteenth in lineal descent from the deified founder. The Asclepiades, in the course of their monopoly, established three schools of medicine, at Rhodes, at Cnidos, and at Cos. The last gave *Hippocrates* to the world, and thus attained a proud and enduring pre-eminence.

Pythagoras (B. c. 600) was the first who brought philosophy to bear upon the practice of the healing art, and led the way in raising it to the dignity of a science. *Democritus*, the happy sage, likewise turned his attention to medicine as a branch of general philosophy, and pursued it zealously. He lived in terms of friendship with *Hippocrates*, by whom he was held in great respect. By *Pythagoras* a school at Crotona was founded, about the time of *Tarquinius Superbus*, espousing doctrines somewhat different from those of Cos and Cnidos. It produced *Damocedes*, a contemporary of *Pythagoras*, who seems to have practised in Athens, an honoured and successful surgeon. By *Polycrates*, king of Samos, he was presented with two talents of gold for having cured him of a troublesome distemper. He was afterwards taken captive by the Persians. Their king, *Darius*, was intrusted to his care for a dislocated ankle, as well as the queen, *Atossa*, for a cancer of the breast; and he was soon loaded with honour and wealth, on account of his wonderful cures, performed after the Egyptian physicians, previously in attendance, had signally failed.

But we cannot suppose such men as *Damocedes* and the Asclepiades to have attained any great proficiency in surgery; for the touch of a dead body was interdicted as a profanation both by Jew and Greek, and consequently they must have been almost entirely ignorant of anatomy. They may have understood something of the skeleton, from their practice among fractures and dislocations; and they may have formed some general idea of the viscera, from researches in comparative anatomy, and from instruction by the Egyptians, whose practice in embalming afforded ampler scope for observation. But the minute structure of the human body must have been to them a profound mystery. And, knowing that anatomy is, was, and ever must be, the foundation of true surgical knowledge, we cannot evade the conviction that surgery, though occasionally successful and honoured in ancient times, must have been nothing more than a rude, imperfect, and uncertain art. The practice of its professors seems to have been extremely limited, consisting of little more than the binding up of wounds, and the staunching of hemorrhage by styptics and the cautery; the extraction of darts and other missiles from the wounds which they had inflicted; phlebotomy, both general and local; and cupping by scarification. Whether they practised the capital operations or not, we are not informed; but it is probable that their comparative ignorance of anatomy effectually deterred them from any extensive division of the soft parts, as extremely hazardous and uncertain.

Hippocrates, born in the 80th Olympiad, upwards of 400 years be-

fore the Christian era, did more for medicine and surgery than all who had preceded him; and indeed few of those who have come after have been of equal service to the profession. He soon freed medicine in a great measure from the absurdities with which ignorance and superstition had invested it; and through a long, honoured, and glorious life he set a splendid example of persevering industry, philosophical research, and high moral worth. His fame soon raised the Coan school far above its rivals. Though his anatomical knowledge seems little better than a blending of ingenuity with error, yet he appears to have had some indistinct notions of the circulation of the blood; although Dr. Pitcairne, in his "*Solutio Problematis de Inventoribus*," has sufficiently evinced that he was very far from anticipating the great discovery of Harvey. With all his deficiencies, and notwithstanding all the disadvantages under which he laboured, so correct was his observation, and so faithful his chronicling of disease, that many of his descriptions may be fairly inserted in our modern nosologies. Though his attention was chiefly directed towards the improvement and promotion of physic, now begirt with philosophy, and studied as a science, and though his practice was principally confined to the treatment of internal disease, yet he was not wholly inattentive to surgery. And his practice seems to have been tolerably bold and decisive; for, in regard to external disease, it was with him a maxim, that "when medicine failed, recourse should be had to the knife, and when the knife was unsuccessful, to fire;" a remedy of which all the ancient doctors seem to have been particularly fond, from Prometheus downwards. Hippocrates employed it not only in a variety of diseases, but in various forms. Sometimes he applied red-hot irons to the part; sometimes he raised a conflagration on it, and of it, by a piece of wood dipped in boiling oil, or by burning a roll of flax after the manner of the modern moxa. He also made use of tents and issues, as more gentle means of counter-irritation. He seems to have performed the capital operations with boldness and success, excepting lithotomy, the practice of which appears to have been confined to a few who made it their exclusive study. He, however, recommends the removal of calculus, large and firmly lodged in the kidney, by incision; adding, probably in apology for the daring of the procedure, that otherwise there are no hopes of a cure, and that the disease must prove fatal. He reduced dislocations, and set fractures, but clumsily and cruelly; extracted the fœtus with forceps when necessary; and both used and abused the trepan, employing it not only in depression and other accidents of the cranium, but also in cases of headach, and other affections, to which the operation was inapplicable. In cases of empyema and hydrothorax, after ascertaining by percussion that fluid was present in the cavity of the chest, he did not hesitate to make an incision between the ribs; and having allowed part of the fluid to escape, he placed a tent in the wound, and by withdrawing it regularly once a day, the whole was ultimately evacuated. He seems to have been perfectly acquainted with tetanus and spontaneous gangrene; observing, that even minute wounds of tendinous parts, as the fingers and toes, sometimes produce convulsions which terminate fatally; and that black spots on the feet frequently increase

to extensive gangrene and incurable mortifications. Some of his practices have been long and justly exploded, some have been successfully continued, and others have, after disuse, been revived as modern inventions. For example, his method of ascertaining the presence or absence of fluid in the chest was by percussion, and applying the ear to the part, thus foreshadowing the use of the modern stethoscope. One of his modes of counter-irritation, we have seen, was by burning flax on the part, as in the modern moxa; and he strongly recommends the production of eschars on the back and breast in the earlier stages of pulmonary disease, thus anticipating the supposed valuable discoveries of a celebrated modern charlatan. His writings are elegant, and well repay a careful perusal. By them he made posterity his debtor. His contemporaries were not insensible to his merits, and endeavoured to reward them during his life. The inhabitants of Argos voted him a statue of gold; he was more than once crowned by the Athenians, and, though a stranger, was initiated into the most sacred mysteries of their religion, the highest distinction which they could confer; after his death, universal and almost divine honours were paid to his memory; temples were erected to him, and his altars covered with offerings.

We have already seen that surgery had long been stationary before the time of Hippocrates; and it made but little advancement during many succeeding generations. The Aesclepiades had confined the knowledge of medicine among themselves; Hippocrates, however, gave oral instructions in anatomy and the art of healing, and thus disclosed its mysteries to the world. But few of his disciples seem to have profited much by his liberality. One of them, his kinsman Ctesias, we are told, acquired considerable renown for his skill; and having been taken prisoner by Artaxerxes Mnemon, in a battle fought against his brother Cyrus, was successful in curing him of a severe wound, and thus obtained favour with his captor. Plato began to flourish about this time (B. C. 370;) but though he was connected with medicine, we cannot lay claim to him as eminent in surgery; and he was more famous for his philosophy than his physic. Perhaps the most distinguished in surgery, among the more immediate successors of Hippocrates, was Dicoles Carystus. He devoted more attention to anatomy than any of his predecessors, was curious in bandaging wounds of the head, and invented the bellulon, an instrument for extracting darts. Carrying his surgery into the practice of medicine, he was not very happy in the result; from observing that external wounds, abscesses, and inflammations were attended with fever, he supposed that general fever was uniformly occasioned by one or more of these causes operating internally. He followed Hippocrates in practice, and, like him, cultivated his profession, "not for lucre or vainglory, but from real love of the medical art, and a pure spirit of humanity." Praxagoras of Cos was the last of the Aesclepiades who succeeded in leaving a name behind him. As a surgeon he is reported to have been bold in the extreme, incising the fauces freely, and excising portions of the soft palate, in bad cases of cynanche; and making incisions into the bowels to remove obstructions, when milder measures failed. He is said to have been the first to distinguish between arteries and veins, and to observe the

pulse as an index of the general system. Aristotle, the celebrated preceptor of Alexander the Great, although not strictly in the medical profession, was the promulgator of doctrines which for a long time had a powerful effect on medicine. While he followed out the general principles of the healing art, and was curious in anatomical research, giving the aorta its name, and showing that all blood-vessels centre in the heart—he seems to have disdained to meddle with the practical details, and among the rest those of surgery.

On the dismemberment of the vast empire of Macedonia after the death of Alexander the Great, learning took up its chief abode at Alexandria, under the protection of Ptolemy Soter, (B. C. 300.) And here it was that popular prejudice first gave way, and permitted the examination of dead bodies, the greatest possible boon to the medical profession, inasmuch as it removed what had hitherto been the most serious obstacle to its advancement, ignorance of human anatomy. Herophilus and Erasistratus, the two great heads of the Egyptian medical school, were the first who had an opportunity of practising human dissection, the bodies of criminals having been given to them for that purpose; and they consequently, not only corrected many errors, but made numerous and important discoveries in anatomy; thus imparting a fresh stimulus, and affording a new and more solid basis to both medicine and surgery. By some they have been accused of carrying their enthusiasm in this inquiry to such an extent as to “open the bodies of living criminals for the furtherance of their physiological views;” this, however, is probably a mere exaggeration, originating in the horror with which human dissection was at first regarded. But we find even these privileged men falling into most palpable mistakes; for example, Herophilus plainly confounds the tendons and ligaments with the nerves. Yet the fact that the names which he gave to many parts still remain in use, will of itself remind posterity how much they are indebted to him for his anatomical labours. He was likewise one of the greatest surgeons of ancient times, and, as well as Erasistratus, acquired as much fame for brilliant cures as for anatomical knowledge. The surgical practice of the latter was characterized by peculiar boldness and decision, and strongly marked with the failing of his time and school, a love of multiplying and inventing murderous implements, and the relentless use of them. “In schirrosities and tumours of the liver, he did not scruple to make an ample division of the integuments, and try applications to that viscus itself. He followed the same practice in diseases of the spleen, which he regarded as of little consequence in the animal economy.” And perhaps he was right in his supposition, though not in his practice. In cases of retention of urine, he made use of the particular catheter which long bore his name. Xenophen of Cos, said to have been a follower of Erasistratus, seems to have been among the first who arrested hemorrhage from a member, by encircling it tightly with a ligature. Mantius, a pupil of Herophilus, wrote a treatise on surgical dressings, which he rendered complicated in the extreme. Another, Andreas of Carystus, wrote on the union of fractured bones, and invented several ponderous machines for reducing luxations of the femur. Indeed, the

surgeons of the Alexandrian school were all distinguished by the nicety and complexity of their dressings and bandagings, of which they invented a great variety. Among them, as in the time of Hippocrates, lithotomy was practised by particular individuals, who devoted themselves exclusively to that operation; and we are told that one of them, Ammonius, employed an instrument, by means of which he broke down stones in the bladder, plainly anticipating Civiale, and furnishing a marked example to the present age of the truth of Solomon's apophthegm, that "there is nothing new under the sun."* It is not improbable that some of their other practices might have afforded equally striking examples of this sometimes unpalatable truth; but unfortunately the greater part of the writings of the Alexandrian school perished in the conflagration of the famous national library, in the time of Julius Cæsar; a calamity fraught with immense loss to the healing art, as well as to almost every other branch of knowledge.

The arts and sciences followed the seat of empire in its transfer to Europe under Julius Cæsar, and Rome became the grand centre of intellectual illumination. Notwithstanding the shrewd sense displayed by the ancient Romans in most matters, it is strange, yet true, that for centuries all ranks of society, from the mere plebeian rabble to the censor, had entertained an abhorrence of all practitioners of medicine and surgery, and trusted for cures to spells and incantations. Indeed, public edicts were issued, "discouraging all countenance to the professed exercise of physic, and recommending faith in traditionary prescriptions and religious rites." Cato the censor managed the sick of his own family according to the terms of this edict, and gravely wrote down the words of incantation for curing dislocation or fracture. For nearly the first six hundred years of its existence, Rome, accordingly, had no regular practitioner of medicine. The first we read of was Archagathus, a Greek, from the Alexandrian school, who practised in Rome, chiefly as a surgeon, during the consulates of Lucius Æmilius and Marcus Livius. At first his surgical skill obtained for him no inconsiderable fame, but the ancient prejudice soon revived in full vigour. An enraged populace—perhaps not without some reason, for he seems to have been particularly fond of the knife and cautery—compelled him not only to suspend his practice, but, changing his original title of "healer of wounds" to that of "executioner," caused him to be banished from the Roman capital. Afterwards, however, a native of Bithynia, assuming the name of Asclepiades (b. c. 96,) established himself in tolerable repute, by virtue of insinuating manners, shrewd common sense, and the performance of several fortunate cures "*tuto, cito, et jucunde.*" But with him we have little concern, for his saga-

* A curious illustration of this is given by Dr. James Johnson, in the narrative of his visit to Pompeii. "The Dilator or Speculum, for which Mr. Weiss of the Strand obtained so much repute a few years ago, has its exact prototype in the Bourbon Museum at Naples. The coincidence in such an ingenious contrivance would be absolutely miraculous; but unfortunately there is a key to the similitude, which destroys the charm of astonishment. A crafty Frenchman imitated from memory, and with some awkward deviations, the Pompeian Speculum, and passed it off as his own. Weiss improved upon the Frenchman, and hit upon the exact construction of the original! Many modern discoveries may probably have originated in the same way."

city soon taught him that it was essential to his welfare to avoid the unpopular practice of surgical operations, and, accordingly, he confined himself entirely to the apparently less hurtful administration of medicine. The only important traces of his surgical practice are, that in ascites he practised and recommended discharge of the accumulated fluid by minute punctures of the abdominal parietes; and that for quinsy, which term probably comprehended many of the various acute diseases of the throat now known and distinguished, he not only employed bold blood-letting, local and general, by the lancet and by cupping, but also had recourse to scarification of the fauces, and even attempted laryngotomy. By novel and successful cures in his medical practice, and frequent indulgence in skilful quackery, he obtained great personal reputation, and so far overcame popular prejudice as to establish a tolerably fair field in Rome for future practitioners. He was the contemporary of Cæsar, and the personal friend of Cicero. The latter is eloquent in his praise, and through him seems to have formed a high estimate of the medical character. "Nothing," says he, "brings men nearer to the gods, than by giving health to their fellow-creatures." It would thus seem that, in his time at least, the ancient grudge against the doctors had abated in Rome. Among the disciples and immediate followers of Asclepiades was Cassius, described as Iatro-Sophista, who left behind him several works on anatomical and surgical subjects. In one of the latter he distinctly accounts for injuries on one side of the head producing paralysis on the other, from the decussation of the nervous fibres; a tolerable proof that he was not only a good anatomist for the time, but also an observant practitioner.

Rome itself did not produce a single medical practitioner of any reputation before the age of Aulus Cornelius Celsus, although he himself chooses to be complimentary to some of his immediate predecessors, "Tryphon, Euelpistus, and Meges, the most learned of them all." Celsus, the contemporary of Horace, Virgil, and Ovid, likened to Hippocrates for the quantity of his sound practical information, and to Cicero for the elegance of his style, lived in the reigns of Tiberius, Caligula, Claudius, and Nero, in the beginning of the first century of Christianity, upwards of a hundred and fifty years before Galen.* In his celebrated medical work, he places great reliance on Hippocrates and Asclepiades, more particularly the latter, and gives a complete and excellent digest of all the true medical and surgical knowledge of his times, although it is not certain that he himself either practised medicine or operated in surgery. "Of his surgical operations and remarks, many are yet far from being obsolete, and impress us with a high idea of his ingenuity and judgment. His mode of performing lithotomy (on

* A life of Celsus by Joannes Rhodius is subjoined to a second edition of a work of that learned Dane, entitled "*De Aciâ Dissertatio, ad Corneliî Celsi mentem, qua simul universa Fibulæ ratio explicatur.*" Hafniæ, 1672, 4to. We must likewise refer our philological readers to "*Jo. Baptistæ Morgagni in Aur. Corn. Celsum et Q. Ser. Samonicum Epistolæ, in quibus de utriusque Auctoris variis Editionibus, Libris quoque manuscriptis, et Commentatoribus disseritur.*" Hagæ-Com. 1724, 4to. The prænomen of Celsus appears to have been Aulus, and not Aurelius, which is a "*nomen gentile.*" See Fabricii *Bibliotheca Latina*, tom. ii., p. 37, edit. Ernesti.

the gripe) has been in recent times warmly defended by Heister, especially as applicable to children. He describes the operation for cata-ract by depression, and the method of forming an artificial pupil. The whole of his account of injuries of the head is admirable, and evinces wonderful tact and discrimination. His rules for distinguishing fracture, and for the application of the trepan, have been highly eulogized; nor is what he says about contrecoups less accurate. He is the first who has remarked that there may be rupture of a vessel within the cranium without fracture or depression." And he is the first who recommended the application of ligatures to a wounded artery, with the view of arresting its hemorrhage, after pressure has failed. He improved amputation, an operation then not much in use; and recommended its adoption in cases of gangrene from external causes. He is minute in his details as to the treatment of fracture and dislocation; his description of carbuncle is good, and its treatment similar to that now pursued, namely, free application of the strongest escharotics to the gangrened part. He describes several species of hernia, and gives directions for their reduction; and also mentions the operation of hare-lip. "It would be endless, however, to particularize. Whoever wishes to know the exact state of surgical knowledge in the world at the time of the Cæsars, may turn to the pages of Celsus, with the hopes of a gratification which will not be disappointed."

He relates an interesting anecdote of Hippocrates, illustrative of his abuse of the trepan. "Knowing and skilful as he was, he once mistook a fracture of the skull for a natural suture; and was afterwards so ingenuous as to confess his mistake, and leave it on record." To this he adds, "This was acting like a truly great man: little geniuses, conscious to themselves that they have nothing to spare, cannot bear the least diminution of their prerogative, nor suffer themselves to depart from any opinion which they have embraced, how false and pernicious soever that opinion may be; while the man of real ability is always ready to make a frank acknowledgment of his errors, especially in a profession where it is of importance to posterity to read the truth;" a moral which cannot be too often forced upon our attention.

Aretæus, born in Cappadocia, practised in Rome, probably about the time of Domitian (A. D. 50-80.) He was the first who made use of blisters, using cantharides for that purpose. He brought the operation of bronchotomy into disuse; conceiving that the untoward symptoms of suffocation were increased thereby, and that the wound was incapable of healing. Dissection in his time was prohibited under the severest penalties: his anatomical knowledge was therefore neither profound nor exact; "nevertheless he had the sound penetration to regard anatomy as the only legitimate basis on which either medical or surgical science could rest." Rufus, the Ephesian, who seems to have lived in the time of the Emperor Trajan, (A. D. 96-117,) was a zealous anatomist and surgeon, and has left a treatise on diseases of the kidneys and bladder. He tied an artery which had been wounded in venesection, and became aneurismal, at the bend of the arm. From the time of Celsus, the aneurismal formations, if treated at all, had hitherto been attacked exclusively by incision, and the actual cautery. Heliodorus, the cele-

brated physician of Trajan, has left some excellent observations on injuries of the head. Antyllus, by some said to have been almost a contemporary, by others not to have flourished till A. D. 340, was a zealous and successful surgeon. He boldly recommends bronchotomy in cases of threatened suffocation induced by disease of the throat; and, in inflammatory affections of emergency, advises arteriotomy in preference to venesection, showing that excessive loss of blood thereby need not be dreaded, it being readily prevented by dividing the artery completely across. He continued the use of ligature in the operation for aneurism, begun by Rufus; his method being to tie the artery above and below the tumour; then to incise the cyst, and procure its closure by granulations. He also alludes to the operation for cataract by extraction, which he, however, recommends very cautiously, and only when the cataract is small. He obtained the radical cure of hydrocele by free incision of the parts. About the commencement of the second century, Archigenes the Syrian settled in Rome, and distinguished himself both in medicine and surgery. His writings, which were chiefly confined to the latter subject, are unfortunately lost. Between Celsus and Galen, however, we meet with no great Roman writer on medicine or surgery. These were among the last of the liberal arts that were encouraged by the Romans; and the proud patricians refusing to educate any of their family to such a profession, the medical practitioners of Rome were at first importations from Greece and Alexandria, and afterwards self-educated slaves and freedmen.*

Claudius Galenus was born at Pergamus, in Asia Minor, in the 131st year of the Christian era. After studying at Smyrna and Corinth, he completed his medical education at Alexandria, and ultimately settled in Rome, where he soon obtained a great reputation both as a successful practitioner and as a public lecturer on anatomy. Professional jealousy of his talents, however, drove him from Rome, to which he did not return until recalled by Marcus Aurelius. Shortly afterwards he was appointed physician to the young emperor Commodus, with whom, as well as with the public, he rose to great favour. A man of great erudition, brilliant genius, and indomitable industry, he produced works which exerted a most powerful and extensive influence over medical practice. He has the merit of rescuing medical inquiry from the chaos in which he found it, and restoring it to the paths of light and nature. His fame indeed was so great as to prove, in one sense, detrimental to the advancement of the medical profession, inasmuch as his opinions were received as oracular in the schools of all the civilized

* On this subject, a remarkable controversy took place in England during the earlier part of last century. It was occasioned by Dr. Mead's "*Oratio Anniversaria Harveiana, in Theatro R. Medicorum Londinensium Collegii habita, ad diem xviii. Octobris, m̄dcccxxiii. Adjuncta est Dissertatio de Nummis quibusdam a Smyrñæis in Medicorum honorem percussis.*" Lond. 1724, 4to. This was followed by a publication of Dr. Middleton, "*De Medicorum apud veteres Romanos degentium Conditione Dissertatio; qua, contra viros celeberrimos acobum Sponium et Richardum Meadium, servilem atque ignobilem eam fuisse ostenditur.*" Cantab. 1726, 4to. To this dissertation Dr. Ward of Gresham College published an answer in 1727: Middleton published the first part of the defence in 1728, and Ward having rejoined in the course of the same year, his antagonist prepared a second part, of which Dr. Heberden printed a few copies in 1761, eleven years after the author's death.

countries for no less a period than 1300 years, thus seriously retarding further investigation. His works were both numerous and elaborate; but, unfortunately, he seems to have been debarred from the study of the groundwork of his profession, human anatomy. His dissections appear to have been limited to the simiæ and other mammiferous animals, as most resembling the human structure, though on one occasion "he felicitates himself on the opportunities he had enjoyed of examining two skeletons preserved in Alexandria, and recommends all anxious to obtain a thorough knowledge of osteology to repair to that city." In his early years, he practised surgery at Pergamus with marked success; but in Rome he seems to have confined himself almost entirely to medicine, excepting the occasional performance of phlebotomy: probably the valorous Romans had not yet lost their hatred and dread of the terrible operations of surgery. Like others, however, he was still so much of a general practitioner, as to practise pharmacy as well as medicine, with a little of surgery: and he himself informs us, that he had a drug-shop in the Via Sacra. "He established two general principles as the basis of all surgery—synthesis, or the reunion of parts—diæresis, or their complete division, as by amputation or extirpation. In four cases he detected luxation of the femur backwards, a variety not mentioned by Hippocrates; and records two instances of spontaneous luxation of the same bone. He also treats of more than one species of hernia. But although in his writings we meet with a few bold chirurgical attempts, as in the application of the trepan to the sternum in a case of empyema, yet it must be confessed that by far the greatest part of his surgery seems to have been confined to fomentations, ointments, and plasters, for external affections, together with the art of bandaging, a love for which he necessarily acquired at the Alexandrian schools; and the employment of complicated machinery in fracture and dislocations." His researches were not limited to medical science, but comprehended literature and philosophy.*

The early Christians are alleged to have unfortunately injured medicine and surgery, by attributing to martyrs and their relics the power of healing wounds and curing diseases; "acknowledging the active interference of demons and blessed spirits in the affairs of men, and leaving true philosophy in total abandonment."

A Cimmerian gloom was now fast overspreading the world, by which science and art were destined to be long obscured; and shortly after the time of Galen, we accordingly find the medical along with the other sciences encompassed by the dark clouds of ignorance and barbarism. One or two names, however, occur worthy of notice, but more from having preserved than advanced medical knowledge. Oribasius, a pupil of Zeno, lived in the time of the Emperor Julian,

* Here we must refer our classical readers to a most important collection published under the title of "*Medicorum Græcorum Opera quæ cstant. Editionem curavit D. Carolus Gottlob Kühn, Professor Physiologiæ et Pathologiæ in Literarum Universitate Lipsiensi Publicus Ordinarius.*" Lipsiæ, 1821-30, 26 tom. 8vo. Three of the volumes are each divided into two parts. This collection includes the works of Hippocrates, Aretæus, Dioscorides, and Galen. Dioscorides was edited by Sprengel, and the other writers by Kühn.

(A. D. 350,) whose friendship he enjoyed, and became a celebrated practitioner, as well as of great importance in the state. His works are principally compilations, though judicious and useful. His surgery is marked with timidity, discouraging operations, except in most extreme cases, and is chiefly confined to unguents and embrocations. He abstracted blood locally, by making deep and extensive scarifications, or rather incisions, with the knife; a proceeding somewhat resembling the important modern improvement in the treatment of erysipelas, but adopted under different circumstances, and with other objects in view.

During the fifth century the west was repeatedly invaded by the Huns, Goths, Alans, and Lombards. Science greatly suffered in consequence; and no name worthy of remembrance is to be found, until, about two centuries after Oribasius, appeared Aëtius, (A. D. 550,) a native of Amida, and a pupil of the Alexandrian school. "His surgical writings are copious and valuable. His opinions were guided by experience, and his methods of management and cure are characterized by much caution and discrimination. We find a variety of surgical queries and suggestions which had escaped Celsus and Galen, as well as the description of several diseases which have been omitted by Paulus Ægineta. He recommended and practised scarification of the legs in anasarca, and made free use of both the actual and potential cauteries; he cut out hæmorrhoidal tumours; operated for aneurism; tried to dissolve urinary calculi by the administration of internal remedies; and has given a series of interesting chapters on inflammation of the intestines followed by abscess, on encysted tumours, on the varieties of hernia, on diseases of the testicle and castration, on the pricks of the nerves and tendons, and, in fact, on almost every important branch of surgical knowledge. If, mixed up with these, we find some things which the matured experience of ages has abolished, it is less to be marvelled at, than that surgery was already enriched with so many valuable facts and observations. He makes no reference to the reduction of fractures and dislocations, whence it has been plausibly inferred, "that, in all likelihood, quacks were at that time in complete possession of this branch of practice. Better were it for society that it was quite out of their hands now!" He seems to have been the first to open up a field of medical inquiry, which has since been so successfully cultivated—the nature and composition of urinary calculi. He appears also to have turned much of his attention to diseases of the eye, and is the first who speaks of the dracunculus, or Guinea-worm. Alexander of Trallis, a famous physician in the time of Justinian, about the middle of the sixth century, was an author of more originality than either Oribasius or Aëtius. He wrote on diseases of the eye, and on fractures; but both treatises have been lost, which is the more to be regretted, as, with this exception, he confined himself entirely to internal disease. The celebrated Paulus Ægineta, also of the Alexandrian school, lived about the middle of the seventh century, and made both large and valuable contributions to surgery. He frequently performed the operations which he describes, and abandoned the labours of the mere theorist, for the more

valuable results of practical observation and experience. "His sixth book has been considered by many, and not without reason, as the best body of surgical knowledge, previous to the revival of letters." He recommended bleeding from the immediate neighbourhood of the part affected, in preference to general blood-letting, because more effectual; and, for the like reason, opened the temporary artery in cases of very severe ophthalmia. He had recourse to copious venesection, with the view of accelerating painful descent of calculus in the ureter. He opened internal abscesses by caustics, and defined the points at which he thought it advisable to perform paracentesis in the different alleged species of ascites. In lithotomy, having first endeavoured to ascertain the situation of the calculus by the rectum, he made his incision, not in the centre of the perineum, as recommended by Celsus, but to one side of the raphe, as is now practised. Of the impropriety of extensive incision of the bladder he seems to have been well aware, directing that the external wound should be much freer than the internal, and that the latter should be in extent merely sufficient to admit of the passage of the stone. While Celsus limited the operation to patients between nine and fourteen years of age, he sanctions its performance after the age of puberty, but admits that the chances of success increase with the youth of the patient. He described more than one variety of aneurism, pointing out those cases in which he thought it advisable to attempt a cure by operation; and extended this to the aneurisms of the head and joints, excepting only those of the groin, arm-pit, and neck, instead of confining it to the tumours of the arm alone, as had been done by Aëtius. All aneurisms, excepting aneurism by anastomosis, which he clearly and accurately distinguished, he conceived to originate in rupture of the coats of the artery. He performed extirpation of the mamma by crucial incision, and practised both laryngotomy and tracheotomy. He is the first who seems to have performed the latter operation as a means of carrying on respiration during occlusion of the larynx, but naturally enough falls into the error of transverse instead of longitudinal incision. He describes different species of hernia, and did not hesitate to operate when the tumour became strangulated. He is also the first who treats of fracture of the patella. He was pre-eminent as an accoucheur, and was the originator of the obstetric operation of embryotomy. From the time of Paulus, we find no Greek or Roman surgeon of note until the appearance of Actuarius, a Greek, who practised with great distinction at Constantinople, probably about the beginning of the twelfth century, but at what exact period it is impossible to ascertain. Among his writings are found several surgical treatises, which, however, possess no greater merit than as compilations from previous authors.*

Having thus traced surgery from its origin, through the Egyptian, Greek, and Roman dynasties, we come to notice the prolongation of

* Mr. Francis Adams, a very erudite surgeon, practising in the vicinity of Aberdeen, has published the first volume of "The Medical Works of Paulus Aegineta, the Greek Physician, translated into English: with a copious commentary, containing a comprehensive view of the knowledge possessed by the Greeks, Romans, and Arabians, on all subjects connected with medicine and Surgery. Lond. 1834, 8vo.

its feeble existence in Arabia.* From Alexandria, captured by the Saracens under Amrou in 640, knowledge was gradually communicated to Arabia. Its people became acquainted with medicine through the medium of translations of the Greek authors; and the "seat of learning was transferred, for a time, from beneath the shadow of the Cross to the empire of the Crescent; from the classic shores of Italy and Greece, to the warlike followers of Mahomet, and the fiery descendants of Ishmael." Many valuable manuscripts, rescued from the savage destruction of the Alexandrian library, were carefully transcribed or translated into the Syriac or Arabic languages, and dispersed in various directions. The first Arabic translation was made about the year 683, by Maserjawaihus, a native of Syria; but the most eminent in this labour was Honain, called, by way of eminence, "the translator," a Christian, born at Hira in 764. Towards the end of the eighth century, a college was founded at Bagdat by the Caliph Almanzor; and there medicine obtained a permanent footing, under the fostering care of the far-famed Caliph Haroun al Raschid. Public hospitals and laboratories were founded by him for the benefit of students, who are said to have amounted at one time to no fewer than six thousand, consisting chiefly of Christians banished on account of their religion; and the Caliph Almamon surpassed even his predecessors in munificent patronage, extended to every department of art and science, and in unwearied exertions to restore and propagate the various branches of learning. By supplication he prevailed upon the Grecian emperors to send him many works in philosophy; and, employing the best interpreters that he could find, ordered all these books to be translated, and encouraged the industrious study of them by his own personal example. The medical school at Jondisabour, the capital of Chorassan, established by Sapore the First as early as the end of the third century, had by this time risen to great celebrity; and from it Rhazes, Hally Abbas, and Avicenna, derived their medical education. Mesue lived during the caliphate of Haroun al Raschid, in the end of the eighth century, and Serapion during that of Almamon, about a century later; both eminent medical men in their time, but both pure physicians. The first Arabian worthy in the surgical department was the celebrated Rhazes, who presided over an hospital at Bagdat in the end of the ninth and beginning of the tenth centuries. His works are not remarkable for anatomical knowledge, which is not surprising, since the study of anatomy was strictly forbidden by the Mohammedan religion, and consequently the Arabians had to rest contented with the writings of the Greeks on that subject. "One of their religious prejudices against dissection was, that the soul did not instantly forsake the body, but lingered in some particular portion of it, for some time after apparent dissolution, so that the dismemberment of it might be a species of hideous martyrdom;" a very sufficient reason why a professor of such

* Le Clerc, *Histoire de la Médecine*. Genève, 1696, 8vo. Amst. 1723, 4to. Freind's *History of Physick*, from the time of Galen to the beginning of the sixteenth century. Lond. 1725-6, 2 vols. 8vo. Le Clerc only continues the history till the age of Galen. The literary history of the Greek physicians may be sought in the *Bibliotheca Græca* of Fabricius.

a belief should strenuously object to the anatomization of himself and his friends. Rhazes is the first who has described *spina ventosa* and *spina bifida*. Of the real nature of the latter, however, he does not seem to have had any clear idea. Regarding cancer, he advised that the knife should never be used except when the disease was limited, and the whole tumour could be completely removed; condemning the opposite procedure as cruel and unavailing; an opinion which after-experience has shown to be most just and true. In bites from rabid animals, he first cauterized the wounds, and then prescribed emetics to expel the "black bile," an evacuation considered most essential to the cure. His account of hernia is better than any to be found in the Greek writers. His works on surgery, however, are little more than compilations from Hippocrates, Oribasius, Aëtius, and Paulus. His confidence in oculism does not seem to have been great; for, having in his old age become blind from cataract, he could not, though urged, be prevailed upon to undergo an operation for its removal. In his time, lithotomy, and some other operations, seem to have been entirely in the hands of juggling impostors. Hally Abbas, surnamed the Magician, on account of the extent of his knowledge and acquirements, lived in the end of the tenth century. His great work, the *Al-meleky*, written about the year 980, is, in its anatomical and physiological department, a mere transcript from the Greeks; and his surgery possesses but few peculiarities. "From the idea that caustics were efficacious when a redundancy of the humours flowed to a particular part, he recommended their application for the cure of hydrocele. In the management of dropsical affections, his attention was always directed to the remote causes; and he preferred puncturing in the *linea alba*, a little below the umbilicus, for the relief of ascites." Avicenna, who divides with Rhazes the honour of having first introduced chemistry into physic, flourished later than the two preceding Arabians. He was termed, in his day, the Prince of Physicians, and seems to have been regarded as almost miraculous for the extent and variety of his knowledge. He was born in 980, and died in 1036, without a rival, either in the medical profession, or in general science. In his great medical work, the *Canon*, the surgical department is not altogether forgotten, but holds a second place to physic; indeed, before the appearance of *Albucasis*, surgery seems to have been all but extinct amongst the Arabians. He has distinguished between closure of the pupil and cataract, and in operating for the latter recommends depression; extraction he considers a very dangerous experiment. It is probable that to him we owe the first use of the flexible catheter, as also of the instrument commonly known as *Hey's saw*. His works are said to have remained the oracles of medical knowledge for nearly six hundred years. *Albucasis*, who died in 1122, exerted himself more than his predecessors in behalf of surgery, which, by his own account, he found in a most deplorable condition; and he is chiefly distinguished as a surgical writer. Cauteries and caustics seem to have been his favourite remedies; and he becomes enraptured when speaking of the "divine and secret virtues" of fire surgically employed. The actual cautery he looked upon with veneration, and describes more than fifty affections in which his experience had

found it beneficial. He is minute in his directions for its application, and forbids its use, "except by persons acquainted with the anatomy of the frame, and the position of the *nerves, tendons, veins, and arteries*;" from which latter circumstance some idea may be formed of the extent to which he himself was in the habit of roasting his unfortunate patients. He checked arterial hemorrhage by his favourite method of cauterization, but also employed styptics, as well as complete division of the vessel and ligature. He is supposed to have been the first to remark, that it is by the formation of a coagulum in the orifice of an artery that its calibre is closed and hemorrhage arrested. He has described a particular instrument of his own for the cure of fistula lachrymalis, and the needle used by the surgeons of Irak for cataract. He speaks of operating for the relief of hydrocephalus, but the success of the practice does not seem to have been greater then than in its revival in our own time; for he confesses that he knew of but one successful case, and therefore does not recommend the operation. He seems to have been conversant with the mode of removing tumours by ligature when the knife is inexpedient; he advises amputation in gangrene of the extremities; and is the first who has described the mode of extracting calculus by incision in the female. His method of lithotomy resembled that practiced by Paulus Ægineta; and, like him, he seems to have been bold in puncturing and excising the tonsils, removing the uvula when obstinately relaxed, and extracting polypous tumours from the fauces. He mentions bronchocele as occurring most frequently among women; but, fond of the knife and cautery as he was, he does not seem to have employed either for the removal of that tumour; indeed, he tells us of "an ignorant operator, who," in attempting extirpation of a bronchocele, "by wounding the arteries of the neck, killed the patient upon the spot." He invented the probang, for dislodging foreign bodies from the gullet; and in wounds of the intestines, practised union of the divided parts by suture more than once with success. Though thus bold in his operations, and, like all the Arabians, too fond of the employment of instruments, he was not, however, without judgment and caution. For example, he condemns tracheotomy as worse than useless when the inflammatory action of the windpipe is acute, and has extended to the bronchi; an opinion which is acknowledged as true, though unfortunately not always followed in the present day. And he exceeds even Rhazes in his dislike to operative interference with cancerous tumours, declaring that he never either cured, or saw cured, a single instance of that disease; a conclusion too nearly consistent with the history of that most implacable malady in all succeeding ages. His remarks on abscesses are most judicious; directing particular attention to their situation, and recommending their being early opened, whether "matured" or not, when in the neighbourhood of joints or other important parts, which would be injured by their continuance; a rule of practice which, if more faithfully followed, would materially diminish the number of diseased joints and bones. He also advised what has since been so much insisted on by Mr. Abernethy, that when the abscess is very large, its contents should be evacuated by degrees. He is the only one among the ancient writers on surgery

who has described the instruments used in each particular operation. Avenzoar, a Spanish Arab, practised physic with distinction, about the beginning of the twelfth century, at Seville in Andalusia. He describes inflammation and abscess of the mediastinum, from which he had himself suffered; and mentions a case of abscess of the kidney, from which fourteen pints of matter were evacuated. He speaks of bronchotomy as expedient in dangerous cases of inflammation of the tonsils: and in stricture of the gullet proposes three modes of treatment; the occasional passage of a tin or silver tube; the use of a milk bath, that nutritious particles may be taken up by the pores of the skin; and the injection of nutritious fluids by the rectum. He also details cases of "rupture, fracture of the hip-bone, wounds of the arteries and veins, tumours, and other varieties of surgical disease, which he appears to have understood well, and treated with discretion." He does not complain, like Rhazes, that lithotomy was in the hands of mountebanks, but tells us that the Arabians then reckoned such operations "filthy and abominable, and unfit for any man of character to perform;" and held that "no religious man, according to the law, ought so much as to view the genitals." The brightest name in the history of Arabian philosophy is that of Averrhoes, the pupil of Avenzoar, born at Cordova about the middle of the twelfth century, and said to have died in the year 1206. But he cultivated the study of medicine only as a branch of general philosophy, and surgery he seems to have altogether neglected.

Such were the Arabians. Of these, Albucasis was the most famous in surgery, as Celsus had been among the Romans, and Paulus Ægineta among the Greeks. But even he could not escape the unfortunate failing of the Saracenic school; endless invention of manifold and complicated instruments, attaching far too much importance to the mechanical part of their profession, and mistaking the inspiration of terror and infliction of cruelty for energetic and judicious surgery. In order, for example, to arrest hemorrhage from a wounded surface, if time pressed and assistants were scarce, it was not uncommon to dip the part into boiling pitch, a liquid which was then dignified with the appellation of a styptic. They, however, systematically divided physic, surgery, and pharmacy into three distinct professions: and so, by commencing the division of labour, may be considered as having done something not unimportant towards the ultimate advancement of medical knowledge. "The last traces of their intellectual illumination appeared among the Spanish Moors in the thirteenth century, when the Christian arms having become more and more powerful, they were compelled to substitute the field for the study—the sword for the pen—and, before an overwhelming opposition, were at length driven from a region whose fields they had tilled, and whose olives they had gathered, for a thousand years. With the decline of the Saracenic school, the daylight of science went down over the nations; and an intellectual darkness, which endured for three hundred years, enveloped the general face of society. All the fountains of science were dried up, and the world seemed retrograding into the unilluminated chaos of ignorance."*

* Moir's Outlines of the Ancient History of Medicine. Edinb. 1831, 16to. Of this excellent work we have not scrupled to make free use in the course of the preceding observations.

A knowledge of the Greek and Arabian systems of medicine was introduced into Italy, at Salerno, in the beginning of the eleventh century; and this school soon rose to celebrity as a seat of medical learning. In the time of the Crusades, Salerno was a place of great resort for warriors of all nations passing between Europe and Palestine; and by these wanderers, on their return, the light of medical science was thence slowly conveyed over Europe. It obtained the privileges of a university; but the medical school of Salerno did not long retain its high reputation. In modern times, it is chiefly remembered on account of the *Regimen Sanitatis Salernitanum*, a singular production, of which more than one hundred and sixty editions are known to have been published. Though written in the name of the *Schola Salernitana*, it has generally been ascribed to Joannes de Milano. The English king to whom it is addressed is supposed to have been Robert of Normandy, whose claims to the English crown were recognised by some of his contemporaries. The poem opens with these lines:

Anglorum Regi scripsit Schola tota Salerni,
Si vis incolumem, si vis te reddere sanum,
Curas tolle graves, irasci crede profanum,
Parce mero, cœnato parum, non sit tibi vanum
Surgere post epulas, somnum fuge meridianum,
Non mictum retine, nec comprime fortiter anum.*

In the twelfth century, the Jews practised medicine, not only among their own tribes, but also among the Moors and Christians; and though, like all others of this age, merely treading in the beaten track of the Greeks and Arabians, yet, from their superiority in such learning, they came to be reputed the most skilful practitioners. About the middle of that century, as has already been stated, surgery was completely separated from physic, by the edict of the Council of Tours prohibiting the clergy,† who then shared with the Jews the practice of the healing art in Christian Europe, from in any way causing the effusion of blood, at least as a means of curing bodily ailment. Surgery was in consequence abandoned to the uneducated laity, and sunk to a deplorable state of prostration; it became a mere matter of plasters and unguents; and if any thing happened to be written on the subject, it was but a bad compilation from the Arabians.‡ We shall, however, notice some

* *Regimen Sanitatis Salernitanum*; a Poem on the Preservation of Health, in rhyming Latin verse, addressed by the School of Salerno to Robert of Normandy, son of William the Conqueror, with an ancient translation; and an introduction and notes by Sir Alexander Croke, D.C.L. and F.A.S. Oxford, 1830, 12mo.

† The early clergy claimed the practice of medicine as their peculiar privilege, and, using it chiefly as a means of personal power and gain, disgraced it by ignorance, charlatanism, and imposture. It was to check this that the Roman Council assembled by Pope Innocent II. in 1139, threatened with the severest penalties those monks and canons who applied to the practice of medicine, "neglecting the sacred objects of their own profession, and holding out the delusive hope of health in exchange for ungodly lucre." But even this, though followed by the more peremptory edict at Tours in 1163, where Alexander III. presided, did not make them altogether forego what they found so convenient and profitable. It was necessary to repeat the edict in 1179 and 1216; but notwithstanding, the monks continued still to practice physic, and it was chiefly by their evil influence that the school of Salerno was brought to decay.

‡ The writers of that age were aptly termed by Severinus, Arabistæ.

of the more remarkable events in connexion with it during its temporary abasement. In the year 1271, the foundation of the College of Surgeons at Paris was laid by Pitard, a surgeon of eminence in those days, and whose enthusiasm effected something towards raising his humbled profession. About the same time lived Gulielmus de Saliceto, a professor at Verona, said to have been "a powerful man" in both surgery and medicine. He seems to have earnestly dissuaded men from the copying and study of books in preference to practical experience, and he himself set a better example. In our own country, Gilbertus Anglicanus is the first name connected with surgery; but he seems to have been little more than a compiler from the Arabians. He lived about the beginning of the fourteenth century; and shortly after him appeared John of Gaddesden, author of the *Rosa Anglica*, and said to have been an erudite and ingenious man, as well as a skilful practitioner. About the middle of the fourteenth century, Guy de Chauliac practised with renown at Avignon, and is "accounted one of the revivers of the languishing art." The amputating knife was held in but slight esteem by him, as will afterwards be shown. In his *Chirurgia*, a history of the state of surgery in his day,* we find the first mention of the Cæsarean operation. Contemporary with him was John of Ardern, an English surgeon. He wrote with simplicity and honesty, and may be regarded as a reviver of surgery in that country. In his practice he was peculiarly successful in the treatment of fistula in ano, and thereby acquired a great reputation. He also improved both the use and the construction of the trepan; adding the central pin, and limiting the operation to the severe forms of injury of the head. Valesco de Tarranta, a Portuguese, practised at Montpellier, and wrote on surgery in the beginning of the fifteenth century. He was the first who proposed the cure of cancer by the application of arsenic. About the middle of the same century, lithotomy, the practice of which had hitherto been confined to itinerant and ill-informed operators, was restored to the regular profession by Germain Colot, a French surgeon, high in favour with Louis the Eleventh. He first contrived to witness the operation by the itinerants, then practised it on the dead body, and at last performed it successfully on a condemned criminal who happened to be afflicted with stone, and who consented to undergo the operation on condition of being pardoned if he survived. His success, in having thus doubly saved life, obtained for Colot much renown; and lithotomy ever after continued a regular part of surgical practice.† The fifteenth century contains other two events important to surgery; the discovery of the art of printing, about the year 1450, which gave a new impulse

* Some idea may be formed of the languishing state of surgery at this time, from his division of the surgeons into the following five sects. The first applied cataplasms indiscriminately to every description of ulcer and wound. The second in similar cases employed wine only. The third used emollient ointments and plasters. The fourth, chiefly military surgeons, promiscuously employed oils, wool, potions, and charms. The fifth "consisting of ignorant practitioners and silly women, had recourse upon all occasions to the saints, praised each other's writings perpetually, and followed each other in one undeviating track, like cranes."

† In the beginning of the sixteenth century, cutting upon the staff was introduced by Johannes de Romanis and Marianus Sanctus, and very successfully followed by Laurence Colot, a descendant of Germain.

to science and literature, by rendering the accumulated stores of knowledge more accessible; and the alleged importation of the venereal disease from America, by the first discoverers of that continent, giving the *small* pox as if in exchange, about the year 1493.* In this century also the Turks captured Constantinople, thus overthrowing the last remains of the eastern empire; and by the multitude of Christians who fled from that city many manuscripts of the Greek medical writers were brought to Italy, and their contents thence slowly disseminated over Europe.

Hitherto surgery can scarcely lay claim to an actual revival. Occasional attempts had been made to raise it from its low position, but all proved abortive. At length, however, in the beginning of the sixteenth century, the practitioners of the healing art were happily convinced that the observation of nature was superior to compilation from the ancients, whether Arabian, Roman, or Greek; they consequently ceased to tread blindly and servilely in the footsteps of their predecessors, and a new era arose to the profession. About the same time Vesalius gave birth to anatomy, properly so called; † illuminated by which science, surgery became a worthy object of pursuit to men of talents and education, and under their cultivation it was gradually raised to an enlightened and liberal profession.

The most conspicuous name in this new era of surgery is that of Ambrose Paré, a Frenchman. In this country surgery was then sadly depressed, having retrograded since the time of John of Arden. Its list of practitioners comprised barbers, farriers, sow-gelders, cobblers, and tinkers; and it is not matter of surprise that from among these no name has been handed down as worthy of remembrance. The combination of the practice of surgery with the more harmless manipulations of the barber, was not confined, however, to this island, but existed also in France, and continued in both countries for upwards of two hundred years. The great Paré does not reject the appellation of barber-surgeon, as applied to himself; nor does he seem to think that there is any thing derogatory in the title. He was surgeon successively to

* The first author who clearly describes the venereal disease is Marcellus Cumanus, who wrote in 1495. It was not till 1530 that Fraecastorius wrote his celebrated poem *De Morbo Gallico*, in reference to which it has been said that the elaste and classic elegance of its language was worthy of the best days of imperial Rome, and the melliflence of its versification hardly surpassed by the bard of Mantua himself. By G. Torella, physician to Pope Alexander the Sixth, we are informed that the insane abuse of mercury as a means of cure was not quite a universal practice on the outbreak of the disease; for, in describing some particular forms of mercurial ointment, he himself states that "they destroyed an infinite number of people, who in this ease did not die, but were downright killed; and these bold empirics must give an account, if not in this, in the next world, of their practice, and be drowned in the pit of repentance." It is but very lately that the "pit of repentance" ceased to be useful under very similar circumstances. That the venereal disease existed, however, in Europe, centuries before the return of Columbus from Spain, seems sufficiently established by reference to the earlier authors; Albucasis and Avicenna mention ulcers and warts upon the penis; Gulielmus de Saliceto, 1280, treat of buboes caused by disease of the penis from impure intercourse; and both Valesco and John of Gaddesden (1305–1320) mention pustules and ulcers of the penis from a similar cause.

† A little later in the century, Fallopius taught anatomy at Pisa, and Eustachius at Rome, and to their efforts, as well as to those of Vesalius, the advancement of that science is much indebted. Fallopius died in 1563; Eustachius in 1574.

Henry the Second, Francis the Second, Charles the Ninth, and Henry the Third, of France; and followed the French armies in all their campaigns down to the battle of Moncontour in 1569. His consequent experience of gun-shot and other wounds, on the field of battle, naturally directed his attention to the subject of hemorrhage; and it is to him that we owe the revival and improvement of the method of arresting bleeding from arteries by ligature, and discontinuance of the cauteries and styptics, which, to the disgrace of surgery, had hitherto been in exclusive use for this purpose. Yet so averse are mankind to abandon their ancient customs, that the improvement of Paré was not sanctioned till after much abuse and persecution, directed both against himself and his discovery; indeed, so bitter and unrelenting were his jealous brethren, that he was compelled, for his own safety, to adduce garbled and incorrect extracts from Galen and other ancients, in proof that to them, and not to him, the invention was to be referred. So far he was less in error than he himself supposed, for we have already stated that he has merely the merit of reviving the use of the ligature.* Celsus distinctly advises its employment when pressure fails to stop arterial hemorrhage; and Albucasis sometimes condescended to use it instead of his favourite cautery and cruel styptics. But so little had surgeons in general profited in this respect, before the time of Paré, that amputations usually proved fatal, partly on account of the hemorrhage, partly in consequence of the severe measures employed for its arrest. We find Guy de Chauliac asserting that it was better "to let the limb drop off than cut it off;" and his own operations consisted in placing pitch plasters very tightly round the joint, and thus causing the limb to mortify. Paré was amply repaid by future fame for the opposition which he had at first sustained. He rose to an unparalleled height of popularity with the army, by whom he was absolutely adored. On one occasion, his mere presence among the garrison of a beleaguered city about to capitulate, re-animated the troops to such an extent, that their resistance became more energetic than before, and the besieging army perished beneath the walls. By his sovereigns he was also highly esteemed. From the general massacre on the fearful night of St. Bartholomew he was rescued by the personal exertions of Charles the Ninth, his great merits being appreciated even by that weak and cruel monarch. But he was not content with the respect and praise of his contemporaries; his writings, the result of great experience and accurate observation, freed from the yoke of authority, and digested by genius of a high order, have rendered him immortal. He was the first to use the twisted suture in hare-lip, and similar wounds, copying the mode of application from the manner in which the ladies and tailors of the day wound the thread round the needle, and thus carried both safely in their cuffs or caps. His works, first published in 1535, and afterwards more fully in 1582, exerted a most powerful and beneficial influence upon his profession. The influence was not, however, immedi-

* As an example of how little the hint of Celsus was attended to, we may mention, that Procopius relates how Artabazes perished of a wound in the neck, "the artery of the neck having been cut through, so that the blood *could not be stopped*." Their cauteries and styptics had no effect on the carotid, or its larger trunks.

ate : for at his death the light he had shed was for a time obscured, surgery reverting to the state of degradation in which he found it, in consequence of its baneful association with barberism. Pigras was his successor, but an unworthy one : endeavouring to follow the footsteps of his master, he obscured and almost effaced them. The most interesting of Paré's surgical treatises is that on gun-shot wounds, a class of injuries then of recent introduction, and little understood : the murderous cannon and firelock had not been long in use.

In the seventeenth century, surgery again revived, resuming the impulse which the genius of Paré had imparted. Italy produced Cæsar Magatus, who simplified, and consequently must have improved, the treatment of wounds ; the never-to-be-forgotten Tagliacotius, with his rude repairs of the human face ; and Marcus Aurelius Severinus, a skilful and intrepid operator. At the end of the sixteenth and beginning of the seventeenth centuries, Padua was favoured with Fabricius ab Aquapendente, the preceptor of Harvey, a most distinguished physiologist, and the most eminent surgeon of his time. His *Opera Chirurgica* passed through no less than seventeen editions, and contain not only an excellent digest of surgery as it then was, but also many improvements of his own. To him we are indebted for the modern Trephine, and for the use of the tube after tracheotomy. About the middle of the seventeenth century arose the true father of British surgery, our own Wiseman, the Paré of England. One or two English names are to be found before him : William Clowes, a military surgeon of some eminence, attended the Earl of Leicester's army in the Low Countries, and wrote on gun-shot wounds ; and Lowe, a Scotchman, gave to the world a Discourse on the whole Art of Chirurgery, dated 1612 : but Wiseman, doubtless, is the first Briton worthy of note in surgery. He was serjeant-surgeon to Charles II., and, amidst the horrors of the civil wars had ample scope for the study of his profession. His surgical works, consisting of eight treatises, dated 1676, contain much information, at that time most valuable, and still amply rewarding an attentive perusal. In military practice he strongly advocated immediate amputation, "while the patient is free of fever," in the case of such injuries as rendered preservation of the member improbable, of course allowing the primary shock of the accident to be past ; a point of practice which long discussion in after years served to confirm. It was not till his time that surgeons ceased to believe that gun-shot wounds were necessarily envenomed by the powder and ball, and had to be treated accordingly with potent and cruel dressings. The immortal Harvey, contemporary with Wiseman, cannot, perhaps, be classed among the eminent surgeons, having principally confined himself to anatomy and physiology, yet he is inseparably connected with that science by his discovery of the circulation of the blood ; a discovery which has done so much for the advancement of all medical knowledge, but of surgery in particular. James Young, a surgeon in Plymouth, may be said to have been also contemporary with Wiseman, having written in 1679. He is the first who proposed amputation by a flap, an improvement to which two French surgeons, Verduin and Sabaurin, lay claim ; and he

is also the first who recommends limited compression of the main artery in amputation.

Germany boasts of several eminent surgeons of this time; Fabricius Hildanus, a most successful practitioner, and author of a surgical treatise, dated 1641; Scultetus, author of the work, celebrated for its horrid array of lethal weapons, called *Armamentarium Chirurgicum*, 1653; and Purmann, who displayed too great an attachment to the dangerous representations of Scultetus. Heister, a professor in the university of Helmstädt, wrote a system of surgery, which has been translated into most of the European languages, and is still in high repute.

Holland likewise possessed successful practitioners of surgery, but tainted with an unworthy concealment of their methods of cure. Rau, a native of Germany, though a professor at Leyden, was perhaps the most successful lithotomist that ever lived. He kept his method of operating, which he had been taught by Frère Jacques, a profound secret, and made it a mystery even to his own pupils, as appears from the circumstance, that his two favourites, Heister and Albinus, of a more liberal spirit than their master, in attempting to divulge his secret for the benefit of the profession at large, have varied most materially in their statements. This illiberal spirit pervaded the other branches of medicine as well as the surgical. The famous anatomist Ruysch preserved inviolate the secret of his wonderfully minute injections, although really the discovery of his friend De Graaf; and Roonhuysen, the accoucheur, worked stealthily with his invented lever. The latter was probably the first who had recourse to tenotomy, for the removal of deformity, having divided the sterno-mastoid for wry-neck. The succeeding generation, however, removed the stigma of secrecy from the Dutch; and their great Camper was equally celebrated for the number of his discoveries and the zeal with which he made them known.

From the time of Paré, France produced no surgeons of great eminence until the eighteenth century. In the seventeenth, we find the names of Dionis, Belloste, Saviard, Morel, and a few others of some renown, but not at all equal to their contemporaries in other nations. Some idea may be formed of the then feeble condition of surgery in France, from the fact that Louis XIV. was not cured of a simple fistula in ano until after his life had been in no small degree endangered by repeated abortive operations. That the French can boast of surgeons of the first class in the next century, however, is indisputably shown by the simple mention of Petit and Desault; names that must ever occupy a proud place in the annals of surgery. The former, adding to the most powerful talents great industry, and an innate love of his pursuits, rose rapidly to eminence, though not without much envious opposition, which seems to be the portion of nearly all those who occupy a pre-eminent place in the profession. On general surgery he has left a work of much value; and his treatise on diseases of the bones, though produced at an early age, entitles him to be called the father of that branch of pathology. For many years it remained the best work on the subject. He was the inventor of the screw-tourniquet, and the first who operated for fistula lachrymalis by transfixion of the sac. He contributed largely to the Memoirs of the Royal Academy of Surgery—an institution

which has done much for the advancement of surgery, not only in France, but throughout the world. Its *Memoirs*, containing the result of the labours of many eminent men, constitute a work of the greatest value. Desault, also of high reputation, both as an anatomist and a surgeon, was the first who taught surgical anatomy, and gave clinical lectures on surgery. His improvements on the apparatus for fractures were most important; and a splint invented by him is still in use, modified, for fractures high in the femur. His adaptations of cutting instruments were also good; among others, changing the amputating instrument to a straight knife, instead of the old curved weapon. He was the first who contemplated the cure of artificial anus, resulting from strangulated hernia; and he further improved Paré's revival of ligature of the arteries. The proposal of curing aneurism by ligature of the vessel on the distal side of the tumour, originated with him: a proceeding, however, of which the merit is still dubious. His writings are both valuable and extensive. After the great names of Petit and Desault, not a few French surgeons of the same century, though less eminent, yet deserve mention; Le Dran, a copious and excellent author; Sabatier, famous in the department of operative surgery; Garengeot, Louis, La Motte, Frère St. Cosme,* Portal, Pouteau, Lecat, Chopart, Morand, Moreau, &c.

It is about the middle of the eighteenth century that our attention is first attracted to our Transatlantic brethren. In 1763, lectures on anatomy and surgery were delivered in Philadelphia by Dr. Shippen; and in 1791 the medical school of that city was completely established, under Benjamin Rush, the Hippocrates of Colombia; a school which has since lent valuable aid to the progress of both medicine and surgery.

Our own country was at this time by no means barren in surgery. Percival Pott and John Hunter are names which occur, the one in the middle, the other in the end, of the eighteenth century, and are fully equivalent to Petit and Desault; indeed Hunter may be justly ranked as the greatest man that ever graced the profession. Pott, the best author, operator, and practical surgeon of his time, greatly improved the practice of surgery in England, both by his writings and by personal example. Like Desault, his attention was particularly directed to the treatment of fractures, of which he had some painful experience in his own person, having sustained a severe compound fracture of the leg. He has left a justly celebrated treatise on the subject. On amputation his observations are most important, clearly discriminating

* Frère Jean de St. Cosme, although a monk, was the inventor of the *Lithotome Cachee*, and with it obtained wonderful success and celebrity as a lithotomist. He considered himself specially commissioned by Heaven to cut for stone, fistula, and rupture; and led a life of the greatest practical piety and self-denial, seeking only enough of money to obtain the ordinary necessities of life, and to keep his instruments efficient. Though at first an uneducated friar, he certainly had the merit of having converted the tearing into a cutting operation with success. In 1700 he studied anatomy at Versailles under Du Verney, and then improved his operative procedure by laying the foundation of the lateral operation, as now practised, with the knife. He received a medal from the Senate of Amsterdam, bearing the motto, "*ob cives servatos*," and was presented with golden sounds at the Hague. He taught his operation to Rau and Marechal; the former of whom practised it with remarkable success, but with an unworthy secrecy.

between those cases, of injury more particularly, which demand the operation, and those which do not; at the same time marking the period most advantageous to its performance. Regarding injuries of the head, he wrote with more precision, and at the same time with more originality, than any previous author, and will ever remain a valued authority upon that subject. The same may be said of his description of vertebral disease, he having been the first who clearly distinguished between those curvatures of the spine depending on mere change of form in the bones, and those occasioned by caries or abscess; the latter formidable affection is still known as "Pott's Disease" of the vertebræ. He greatly improved the treatment of fistula in ano, and abscesses in general; and by simplifying the whole art of surgery, discarding the cautery and escharotic unguents, or rather limiting them to their proper place and use, employing also the cutting instruments with caution and reserve, and placing more implicit trust in, and showing more respect for, the powers of nature than had hitherto been the custom, he achieved a most important and beneficial reform. Until his time, the maxim "*Dolor medicina doloris*" remained unrefuted. The actual cautery, for example, was in such general use, that "at the time when surgeons visited the hospital, it was regularly heated and prepared in the wards, and in the presence of the patients, as a part of the necessary apparatus. Mr. Pott lived to see these remains of barbarism set aside, and a more humane and rational plan, of which he was the originator, universally adopted." John Hunter, a native of Scotland, the pupil, first of Cheselden, and afterwards of Pott, though not remarkably distinguished as an operator, was the most gifted surgeon of which the medical profession can boast, and no less eminent as an anatomist, physiologist, and general philosopher. His researches comprehended a wider range than those of Pott, but arrived at the same end, the improvement of surgery. The knowledge obtained by his vast inquiries into physiology, pathology, and human and comparative anatomy, was, with all the power of his genius, brought to bear upon the practice of the profession, and with the happiest success. The doctrines of adhesion, granulation, and inflammation with its various results, were, until explained by him, comparatively obscure and uncertain; and no one is ignorant how much the successful treatment of disease, either by surgery or medicine, must ever depend on an accurate and familiar knowledge of these rudiments. To him we are indebted for the simplification of more than one operation, the discovery of the vitality of the blood, important advice as to the treatment of gun-shot wounds, the enforcement of excision of bitten or poisoned parts, many new facts as to the physiology and pathology of teeth, and other valuable additions to practical surgery. But these assume an unimportant place among his deeds, when placed beside the two with which his name is indelibly associated—the cure of popliteal aneurism by ligature of the femoral artery, and the elucidation of the venereal disease; his work on the latter subject still remaining standard, and in many respects unsurpassed. His improvement of the operation for aneurism marks an era in the history of surgery, being one of the most important of its advances. Dissatisfied with the cruel, formidable, and unsatisfactory operation for popliteal aneurism, by inci-

sion of the tumour and ligature of the vessel at its diseased part, as first practised by Rufus and Antyllus, he made himself aware of the causes of failure by the old system, contemplated the plan of cure which bears his name, satisfied himself of its practicability by diligent study and experiment, successfully brought it to the test of actual practice; and then, extending the principle to all aneurisms, effected for surgery a great triumph over that formidable disease.* His first operation was performed in 1785. Since his time the method of applying the ligature has been considerably improved, and the certainty of success consequently increased. But "the more brilliant a discovery, and the more beneficial its results, the more certain is its author of becoming the butt of envy and the object of detraction." And accordingly we find that Hunter has not been permitted to remain in undisturbed possession of his discovery. Its merit has by some been claimed as due to Aëtius; others, with better hope of success, support the pretensions of Guillemeau (a pupil of Ambrose Paré,) Anel,† and Desault; but a candid inquiry into facts and dates will ever result in ascribing the honour to our illustrious countryman. Had he even been deprived of this, his name must still have been immortalized by other and more palpable labour of his mind and hand—his writings and museum.

In the same century with Pott and Hunter, Britain also produced White, an excellent practical surgeon and lucid writer, the originator of Excision of joints; Cheselden and Douglas, two eminent lithotomists, the former peculiarly successful; Sharp, famed for his Critical Inquiry into the State of Surgery; and Monro, a name indissolubly united with the birth and fame of the Edinburgh medical school.‡

In Italy, where, during the times of Pott and Hunter, several eminent surgeons lived, Lancisi, Morgagni, Bertrandi, Troja, &c.—the labours of Hunter in aneurism were ably followed up by Scarpa, who still farther elucidated the doctrines regarding the new treatment of that disease, and established the success of the operation. He was also eminently successful in his researches as to the anatomy and pathology of hernia, a subject which he has made peculiarly his own. The same century saw in Germany, Schmucker, Richter, and the great Haller, whose *Disputationes Chirurgicae* bear, equally with his other works, the impress of both labour and genius of a high order.

The nineteenth century will not yield to any former era in a numerous and bright array of names dear to surgery. It has seen the fall of Abernethy, Dupuytren, and Cooper, brilliant stars in the galaxy, and mourns others highly valued; but vast and powerful is the host who

* "So discouraging were the results of the old operation, that many surgeons preferred performing amputation of the aneurismal limb."

† Guillemeau and Anel placed their incisions and ligatures in the immediate neighbourhood of the tumour.

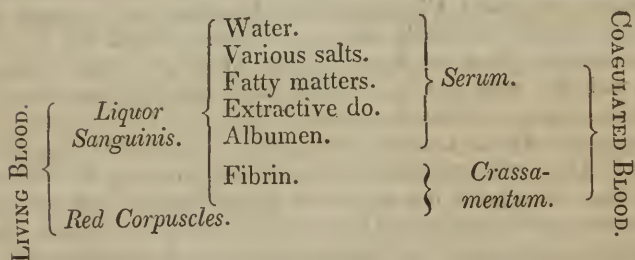
‡ Dr. Monro was appointed professor of anatomy to the company of surgeons in 1719, and during the ensuing year he was appointed to a similar chair in the university. Several other professors in the same faculty had previously been nominated; Sir Robert Sibbald, Dr. Halket, and Dr. Pitcairne, so early as the year 1685. But Dr. Monro was the first who regularly delivered public courses of lectures, and he may in a great measure be regarded as the founder of the medical school of Edinburgh.

are still labouring, with distinguished success, in their noble calling. In all civilized countries, the dark days of the profession have, we trust, for ever passed away; and many are the illustrious names in which it now exults, more particularly in France, Germany, and, last not least, Great Britain.

OCCASIONAL reference to the following diagram of the blood's constitution may be found useful, particularly as the first subject treated of is so intimately connected with important changes in that fluid.

DIAGRAM OF BLOOD.

Chemical Components.



—WHARTON JONES, *Brit. and. For. Med. Rev.*, xxviii. p. 588.

THE
PRINCIPLES OF SURGERY.

SECTION I.

CHAPTER I.

PERVERTED ACTION OF THE BLOOD-VESSELS.

OF INFLAMMATION AND PERVERTED VASCULAR ACTION IN GENERAL.

Inflammation, the source of much evil, medical as well as surgical, may be defined: A perverted condition of the blood and blood-vessels of a part interrupting its healthful function, and changing its normal structure; ordinarily attended with redness, pain, heat, and swelling; and inducing more or less disturbance of the general system.

This term has, in my opinion, been made to include too wide a range of action—from the slightest exaltation of what is healthy, to the most disastrous results of ravaging disease; rendering the cause of simple effusion one and the same with that of suppuration, ulceration, and gangrene; uniting, as if in one harmonious operation, the healing of a wound with its gaping and suppuration—the gradual enlargement of a part, with its destruction and discharge—the death of a portion of bone, with the formation of its substitute—the successful reunion of a broken limb, with the suppurative arrest and undoing of the callus—the infliction of an ulcer, with its process of healing:—all, however dissimilar, declared the offspring of one common parent—Inflammation.

The practical confusion and tendency to error which inevitably result from such a state of things, seem full warrant to the surgeon at least, for an endeavour to divide what is so extensive and varied, into its component parts; and, considering each disjunctively, to inquire whether separate causes may not thus be found to suit the results so widely different.

With this view, I would, in the first place, limit the term Inflammation to what is *essentially morbid*; that is, at variance with healthy function and structure. The blush of shame, or the red spot of hectic, are

not the same with the fiery tumour of erysipelas; the increased vascular action of the mamma giving milk, is different from that thoroughly perverted vascular action which arrests the secretion, and changes the structure of the organ; the simple turgescence which at once closes a flesh wound, is an action far short of that which renders its lips separate and swollen, pouring out a copious purulent discharge. The one is something not at variance with health: the other is Inflammation.

From health to true Inflammation is not one step, at once attained, but a transition gradually effected—the time occupied varying according to circumstances. In some cases a very few hours suffice; in others, days shall have elapsed, and yet the process is incomplete.

The transition may be conveniently subdivided into three stages:—
1. Simple Vascular Excitement; 2. Active Congestion; 3. True Inflammation. We cannot yet state with certainty the exact details of the process; but believe them to be nearly as follows:—

Theory of the Inflammatory Process.

Let us take a common surgical example—the application of some acrid substance to the skin. Each component texture of this part may be affected, so soon as brought in contact with the irritant, yet it is not improbable that one texture may be involved sooner and more seriously than the others. This one is the nervous; and hence immediate pain, by the effect on its sensory portion. An impression is thus conveyed from the part to the nervous centre; thence follows, by reflex action, a stimulus to the vascular tissue of the part, already roused by the direct influence of the irritant, and that stimulus is in due time obeyed; as if both part and system resented the injury, and had resolved to resist or repair the evil by a functional effort, the greater share in which falls to be borne by the blood-vessels.*

The time which elapses between the application of the exciting cause and the establishment of the vascular action thereby induced, is termed the period of *incubation*; varying as to duration—in some cases very brief, in others protracted—always valuable with regard to treatment.

I.—The action commences with determination of blood to the part; an unusual amount of that fluid reaches it, and is sent through it with an augmented velocity. At first the capillaries and minute arteries—those vessels mainly concerned in the change—are of diminished calibre; a change resulting from an inherent contraction of their walls, or, secondarily, from contraction of the parenchyma, or,—as is most proba-

* Mr. Wharton Jones ingeniously supposes that the initiatory effect on the nerves of the part is double; first, on the sensory nerves; secondarily, on those of motion—producing excitement of the former, depression of the latter. That the exciting cause acts “primarily on the sensitive nerves, exalting their activity. The motor nerves of the vessels which have sympathetical relations with the excited sensitive nerves, are secondarily affected. But this affection of the motor nerves of the vessels, which supervenes by reflex action on the excitement of the sensitive nerve, is not a corresponding state of excitement, but an opposite one of depression, of suspension of action, of paralysis.”—*Brit. and For. Rev.*, 34, p. 552. On this state of secondary nervous depression, he conceives that the subsequent dilatation of the vessels depends.

ble—from both of these circumstances. But soon this spasm or increase of tone in their coats passes off; they gradually yield before the increased and increasing flow, while yet the rapidity of this is by no means diminished. After a short time, the spasm has not only disappeared, and the wonted capacity been regained, but dilatation beyond the normal standard is begun. Capillaries which previously contained but single files of the red corpuscles, now admit of them rolling through in masses, and these come crowding in; in consequence, vessels formerly invisible are now seen plainly; and the accelerated motion of the general current is yet unabated. In such a state of matters, it need afford no surprise to find a tendency to unusual transudation; in other words, along with an increased circulation, comes an increase of the ordinary function of the circulation. The blood parts with a portion of its contents more liberally than in quiet health. The transudation may be at first chiefly serous; but if such action be sustained for some time, the liquor sanguinis is found in the interstitial spaces. The natural function of the part is exalted; if this be secretion, the secreted fluid is increased in quantity, yet with its normal characters scarcely, if at all, changed. Nutrition is exalted: and the fibro-cellular tissue is fuller than before, giving slight increase of bulk. Thus is constituted the first stage, *Simple Vascular excitement*—not inconsistent with health, but rather its mere exaltation—synonymous with the *Vital Turgescence* of some Physiologists. The part contains an increased amount of blood; its circulation is unusually active, and there is a marked tendency to increased exudation, partly serous, partly of a plastic kind.

How such a state is produced, we need not here stop to inquire. According to some, it is by an increased effort of the blood-vessels themselves; while others attribute all to the blood, and to an exaltation of the vital affinities between its own component parts, and between these and the solids through which it circulates. It is not improbable that both causes are concerned in the change.

The exciting cause having been removed, the action may soon subside, and the part regain quiescence; or the exciting cause remaining, the action is sustained, yet without proceeding to a higher grade, and a salutary result is probably secured thereby. For instance, it is by the continuance of such simple action, that the conjunctiva resents the presence of a grain of sand, and often succeeds in washing it away by the increased effusion. But, the exciting cause remaining, or being severe in its nature, though of brief application, there is neither abatement, nor simple maintenance of the action, but advance; and this brings us to the second stage.

II.—*Active Congestion*.—The vascular commotion extends on the cardiac side of the affected part; the arterial trunks feeding it have partaken in the excitement, are begun to enlarge, and are pulsating with an unwonted energy. More and more blood is sent down to the part, and the capillaries and minute arteries begin to give way beneath their burden; hitherto they were simply dilated, retaining their tone, and controlling the circulation of their contents; but now enlargement is about to be merged in over-distention, the vascular coats gradually

parting with their tone.* And partly from this cause, partly on account of change in the blood itself, which seems more viscid, with its corpuscles less distinct, and when examined by the microscope, is found especially to possess an increased number of colourless "lymph globules," unusually adhesive to each other and to the walls of the vessel, and so manifestly operating obstructively—and partly, also, it is probable, from an increase of vital attraction between the blood and surrounding parenchyma—the circulation loses its acquired rapidity, and becomes slower even than in health. The red corpuscles are no longer limited to the central current, but are encroaching more and more on the lateral and clear "lymph spaces." Exudation is more copious than in the previous stage; it consists of serum and of liquor sanguinis, the latter usually predominating: and when the action has been for some time sustained, and, as it were, established in the part, fibrin alone may be deposited. The fibrin of the blood is increased, not only in quantity, but also in plasticity, or tendency to become organized. The natural function of the part is not simply exalted, but begins to be perverted: for example, secretion is not only increased, but changed in its character. By the fibrinous interstitial deposit, the texture of the part is softened and enlarged. The "formative power," as it is termed, of the part is impaired or overborne; the supply of plastic material is greater than can be usefully and normally appropriated by the implicated tissues.† Nutrition, or the normal and vital relation which subsists between the living tissues and nutrient materials contained in the blood, is becoming more and more disturbed; and this, perhaps, constitutes the most important part of the inflammatory process, leading ultimately to change of structure, more or less permanent, and more or less inimical to resumption or continuance of normal function.

Thus is constituted Active Congestion; the arterial trunks in increased play; the amount of the blood in the part still farther augmented; its vessels beginning to be over-distended, and losing tone thereby; its circulation becoming slow; its blood undergoing change, the fibrin especially being increased, both in quantity and plasticity; function and nutrition perverted. We are leaving the confines of health, and have, indeed, already made some progress into the territory of disease.

* "Atony and flaccidity of blood-vessels may become a cause of impediment to a current through them, not by preventing these vessels from actively contracting on their contents, but by removing that tone by which the vessels maintain the calibre and the tension best calculated to transmit onwards the force of the current. Vessels thus weak and inelastic, instead of equably conveying the current, become distended, lengthened, and tortuous in receiving it: and by their very mass, as well as by their inelasticity, they partly break the force of the current, and partly turn it into other channels."—WILLIAMS' *Principles of Medicine*, p. 207.

† "The various solid tissues which are in continual process of change, more or less rapid, derive the materials of their reconstruction from the blood, especially from its fibrin; which they have the power, by their vital endowments, of causing to assume their own respective forms of organization. The vitality of the tissues in any part may vary in its degree; so that their formative power may be increased or diminished. When their formative power is increased, the process of nutrition is performed with unusual rapidity, and the fibrin of the blood is rapidly drawn from it: but when the formative power is diminished, the process of reconstruction is slowly and imperfectly performed, and the demand for fibrin is less."—*Brit. and For. Med. Rev.*, No. xxxv., p. 102.

This action may resolve after the removal of its simple exciting cause; or it may be sustained for some time, as in the healing of wounds, and the closing of ulcers; or it may advance to

III. *True Inflammation*.—The change which, in the preceding stage, had begun in the blood, is now completed. The over-distention of the capillaries is established; the capillary power is for a time gone—perhaps in consequence of diminution or actual suspension of the nervous influence; and the coats of the capillaries and other vessels are thickened, softened, and impaired in cohesion, being themselves the subjects of structural change. The languor of circulation approaches stagnation, and at some points this has actually occurred; every part of the distended capillaries is occupied by crowded coloured and colourless corpuscles; partly, it may be, from increased attraction between the former and the surrounding parenchyma, partly by accumulation and adhesion of the latter to each other and to the capillary walls. The altered liquor sanguinis is exuded in profusion. The capillaries also give way in their coats, and from the lesion blood is extravasated in mass. Suppuration is in progress by extravascular degeneration of the fibrinous effusion, or else by a secretive elaboration of it ere yet it has left the vessel. Breaking up and disintegration of texture ensue, according to the extent of extravasation and suppuration; and the disintegrated texture is commingled with the effusion. The formative power has ceased, and the opposite condition, a tendency to disintegration, from diminution of vitality, has become established. Disorder of function is complete; secretion, for example, being in the first place arrested, and, when restored, more vitiated than before.

Whilst in the circulation of the part truly inflamed all is sluggishness and stagnation, that of the parts around is unusually active. The arterial trunks in the vicinity continue to play with increased energy; more blood continues to be sent, but cannot now be transmitted in its direct course: in the inflamed part it meets an obstruction, and being sent round another way, throws a greater stress on the collateral vessels; these retain vigour sufficient for the augmented labour, and send the current merrily round. But, in their turn, they themselves may be overborne by an extension of the disease, and the active route rendered, at each such extension, more and more circuitous.

While the apparatus of deposit is thus unusually busy, that of absorption is in abeyance. During inflammation, the lymphatics and minute veins do either little or nothing as absorbents. But on the yielding of the action, not only does effusion begin to abate, but, besides, absorption again comes into play, and that actively; and thus the part is often restored nearly, or altogether, to its former state. During inflammation of a serous membrane, for instance, a large amount of liquid effusion often rapidly accumulates within its cavity; so long as the action persists, that fluid either remains stationary or receives an increase; but so soon as the inflammatory process has fairly given way, and resolution is in progress, the effusion plainly diminishes, almost *pari passu*; and in two days, or perhaps in but a few hours, it may have wholly disappeared.

The inflammatory change of the blood is important. 1. The liquor

sanguinis is increased in relative quantity, and its serum is said to contain an unusual amount of albumen. 2. The fibrin is increased in quantity, both actually and relatively to the red corpuscles; the vital attraction between its component particles, tending to aggregation, is also augmented. During Active Congestion, its plasticity was increased, but now it becomes more and more aplastic. The proportion of serum is diminished, probably in consequence of effusion. 3. The red corpuscles are relatively diminished in number; and their tendency to aggregation is augmented. 4. The colourless or "lymph globules" are greatly more numerous; but whether by new formation, or by mere accumulation in the part, has not yet been determined. They incline, not only to aggregation, but also to adhere to the sides of the vessels; thus increasing, or according to some, causing the tendency to stagnation of the blood.



- a*, Colourless globules adherent.
- b*, Blood discs, still circulating in a diminished space.
- c*, Dense, stagnant, homogeneous mass.
- d*, Corpuscles in oscillatory movement, becoming detached from the impacted mass.

WILLIAMS' *Princ. of Med.*

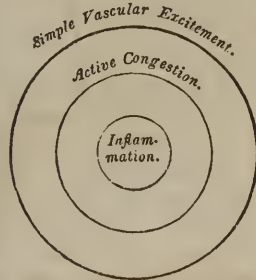
This alteration of the blood, begun in the second, and completed in the third, or true inflammatory stage, is at first a local act, effected in the part inflamed; but this laboratory, if continued thus in operation, ultimately involves the whole circulating fluid in similar change.

Such is Inflammation Proper. Blood much altered; stagnant, or tending to stagnation. The capillaries over-distended passive tubes; their coats thick, soft, and lacerable. The neighbouring circulation,

collateral, unusually active. Exudation of liquor sanguinis, whose fibrin is becoming more and more aplastic: extravasation, by lesion, of blood. Nutrition and function wholly perverted. Structure changed, texture softened and enlarged. Suppuration in progress; and part of the texture breaking up. Nothing healthy or consistent with local health; all essentially disease.

This state is not at once established, so soon as the period of incubation has passed away; but, as already stated, is approached by a process of transition more or less gradual. The previous stages may be either short or protracted, but can, in no case, be proved absent. When the process is somewhat tardy, its compound nature is the more distinct. Take, for illustration, the vaccine pustule; an inflammation resulting from a poisoned wound, and gradually attaining to its consummation. The exciting cause is applied, and for a time seems to be inoperative; three days commonly elapse without the appearance of vascular excitement; and this is the period of incubation. On the fourth day the *papular* condition is established; commencing with simple excitement, and steadily verging towards active congestion. During the four following days the *vesicle* is formed, the result of the crescent second stage of action; the vesicle at first containing mere serum, afterwards becoming of a more glutinous character by exudation of the liquor sanguinis. On the ninth day the *pustular* formation is attained; and not until then has the establishment of True Inflammation been completed. Soon thereafter the vascular action ordinarily subsides, and the part slowly recovers.

During the morbid progress, advancement is usually at and from the centre; and, supposing a section made of the inflammatory disc, the accompanying diagram may conveniently illustrate the state of the part. The outer circle representing simple vascular excitement, whose characteristic effusion is serous; the second, Active Congestion, with exudation of the liquor sanguinis; within the inner circle, True Inflammation, denoted by more or less extravasation and destruction of texture, and the formation of pus in progress. Thus, True Inflammation structurally considered, consists of suppuration, actual or imminent, surrounded by fibrinous deposit, and that encircled by effusion of serum.



It has often been disputed whether Inflammation is the result of an increase or diminution of vital strength in the part—an excitement or a debility; and both extremes have been tenaciously held and argued. According to the preceding account, the fact lies midway between the disputants; the action being found to commence with excitement, and probably an actual exaltation of the part's vitality; this, however, proving usually of short duration, and succeeded by growing debility and much ultimate prostration. Inflammation established, vital *power* is sunk very low. And what is worse, from this overflow, the part, once truly inflamed, never altogether recovers, but ever remains both more prone to action, and less able to control it; a fact which it is of much

importance that both patient and practitioner should bear in remembrance.

Local Symptoms of the Inflammatory Process.

The consecutive changes which I have endeavoured to describe, and whose completion constitutes true inflammation, are ordinarily accompanied and indicated by certain signs; redness, swelling, heat, pain, throbbing, increased sensibility, disorder of function, arrest and change of secretion.

1. *Redness.*—The more fully a part is injected with blood, the redder is its hue. An inflamed texture, as we have seen, has its amount of blood very much increased; its colour is necessarily heightened thereby. And not only are the vessels unusually gorged with blood; that blood is unusually red; much of the liquor sanguinis having moved on from the field of actual or threatened stagnation, leaving the over-distended vessels filled chiefly with an agglomeration of red corpuscles. The *cause* of redness then is obvious.

The extreme vascularity of certain parts when inflamed, the conjunctiva for example, has been supposed to depend in part on the formation of new vessels, a result of the action. This may ultimately be the case; but it is not so in the first instance. Minute capillaries, in health, carrying the red corpuscles in but single files, are invisible to the unassisted eye; inflamed, they are dilated, burdened with corpuscles in mass, and plainly seen; appearing to have grown up suddenly by a new creation, but being in truth only an enlargement of texture previously existing. The formation of new blood-vessels in fibrinous deposit, is a gradual and never an immediate process, as will be explained in the proper place. Such ultimate vascularization is a frequent result or attendant on inflammation, but is incompatible and cannot be co-existent with the true inflammatory crisis, which is adverse to all formation of tissue, and is suppurative and destructive.

The *degree* of redness varies according to the intensity of the action, and the previous vascularity of the part; or, in other words, according to the extent of the vascular engorgement, and the number of vessels which are engorged. It is a familiar test of the violence or forwardness of the disease, to look to the amount of redness. And we find an inflamed tendon less florid than inflamed skin; inflamed skin less red than inflamed mucous membrane.

The *tint* varies according to the character and accompaniments of the action; a bright arterial red is exhibited by what is acute and sthenic; the chronic and asthenic is denoted by a dark, venous, or purple hue; great attendant biliary derangement giving a yellowish red, as in bilious erysipelas.

It is imagined also, that, during the inflammatory remora of the blood, transudation takes place of the colouring matter from the red corpuscles to the plasma, and also from the general mass of blood through the vascular coats to the parenchyma; and that to the extent of this occurrence, the variations in the tint of an inflaming part may be, at least in some degree, ascribed.

The *extent* and *form* of redness vary; sometimes limited to but a spot, as in the pustule or phlegmon; sometimes occupying a large space, as in erysipelas, and the corresponding affection of the mucous surface. Sometimes in one unbroken sheet, as in erysipelas; sometimes in lines or patches, as in inflammation of the veins and of the lymphatics. Sometimes gradually lost by diffusion in the surrounding paleness, as in phlegmon; sometimes carrying an abrupt bright margin, as in the erratic erythema.

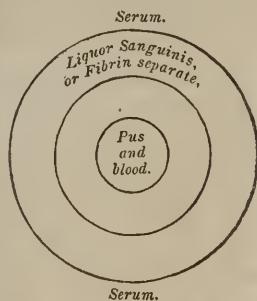
The diagnostic character of inflammatory redness is its *permanency*. Other redness may come and go, as the blush of shame, or the glow of warmth; but that of inflammation is fixed. By the pressure of a finger it may be made to disappear momentarily, but the pale dimple is quickly filled up and coloured as before; all trace of the touch almost instantly vanishes, like the passing of breath from a mirror. The patient may be bled to syncope, and the general surface grow pale as marble; but this will not yet blanch the inflamed part; its redness remains until the action which caused it shall have passed away.

But not only has it no flitting tendency; it must be *conjoined* with other symptoms. The crimson spot on the hectic cheek, is fixed there; but there is neither pain nor swelling; it is not conjoined with other signs; it is not inflammatory.

2. *Swelling*.—The unwonted accumulation of blood will alone occasion this in the part inflaming, as is exemplified by the slight yet palpable elevation of erythematous skin, ere effusion has occurred. But, as a symptom of inflammation, it is mainly caused by escape of a portion of the vascular contents into the intervascular spaces. The action yet nascent, serum is effused; in its second stage, the liquor sanguinis is found, or fibrin more or less separated from its serum; and this fibrin is of high plasticity; in the third, the fibrinous deposit is continued, but of impaired plasticity, and with it is mixed blood extravasated in mass, the result of vascular lesion, and ultimately purulent formation is more or less advanced. So that, again referring to the diagram—centrally we have a soft fluctuating swelling, where there is blood and pus; surround this, a dense and unyielding circle, somewhat diffuse, and usually less prominent than the centre, the result of plastic fibrinous accumulation; and exteriorly to both, a soft pitting œdema, more or less extensive, according as the fibro-cellular tissue has been filled by serous effusion. The combined result is softening of texture, and impairment of cohesion as well as enlargement.

Swelling, like redness, will not alone indicate inflammation; it must be *conjoined* with other symptoms. In simple œdema there may be much swelling, yet there is nothing of the inflammatory process.

It is also of *gradual* and *recent* formation, not suddenly developed, as is the bulging of a hernia or dislocation, or the sanguineous infiltration immediately consequent on a blow; nor of a tedious growth and ancient origin, as is the genuine tumour.



The *tendency* of swelling is beneficial or otherwise, according to the part affected. If this be internal, of delicate texture, and important in function, swelling there may prove in the last degree injurious, as in the brain. Or a part, itself comparatively of little importance, may be in the immediate vicinity of one which is of the greatest; and enlargement of the former may react on the latter most injuriously; swelling of the orbital cellular tissue will so affect the eye-ball; inflammatory tumour of submucous tissue may fatally occlude a mucous outlet—as the glottis. On the other hand, swelling is usually a fortunate occurrence, and encouraged as such by the surgeon; if the part be situated externally, as the ordinary subcutaneous cellular tissue; or if it be neither itself of delicate texture, nor endowed with function essential to the animal economy, nor closely connected with one which is either or both—as the textures occupying the inter-muscular spaces. The over-distended vessels are relieved of part of their burden; and an opportunity, varying according to the extent and rapidity of the effusion, is thus afforded them of recovering from debility, regaining their normal tone, and once more controlling the circulation of their contents. Always provided, however, the effusion from the vessels, and the yielding of the surrounding texture, to receive that effusion, advance consentaneously, and in harmony.

Of this favourable kind are very many of the swellings in an inflaming part, with which the surgeon has to deal, as in erysipelas, phlegmon, fractures, bruise, &c. It is, therefore, an error to regard the amount of swelling as a certain index to the extent of mischief; nor ought even great tumescence to warrant, of itself, a gloomy prognosis. Further, swelling is not to be invariably prevented, or opposed in its progress; on the contrary, it is often to be invited to the part, and, when there, promoted in its advancement. We have seen that the most prominent change effected in the blood by inflammation is increase of the proportion of fibrin; this, therefore, may be regarded as the principal inflammatory ingredient in that fluid. If much of it be extruded from the vessels, either *per se* or along with the serum, it were most reasonable to expect benefit from such an event. And thus we may obtain another reason in favour of swelling as a salutary occurrence.

The exudation of plastic fibrin will afterwards be seen to be farther advantageous, as constituting a most important limit to the central sup-puration, when that occurs.

From what has been said, it is already apparent how the tendency of swelling is prominently connected with the texture of the part; the less yielding, the less favourably disposed for effusion. The action increasing, so does the escape of the vascular contents; but should the texture refuse to accommodate this growing addition to its bulk, there arises, as it were, a struggle between the unloading vessels and the unyielding part, the issue of which is sure to be disastrous. It is the surgeon's office to watch this, and either maintain or restore harmony, if possible. Otherwise, pressure from the pent-up effusion reacts disadvantageously on the blood-vessels and nerves of the part; tension is soon accompanied by throbbing, heat, and violent pain; the morbid

action has received a fresh impulse, and advances accordingly. Or the tightness of the pressure thus caused may be so great, as to arrest altogether the circulation in the part, already inclined to stagnation, and so render gangrene inevitable.

Hence it is that rapid swelling in a loose texture tends always to relief, as in the ordinary fibro-cellular tissue; while swelling in that which is unyielding requires both constant and skilful care, and even then does injury. Acute effusion in bone, beneath a tightly spread fascia, or between bone and its fibrous periosteum, are occurrences invariably severe, and prone to result in destruction of texture. Acute action, with rapid effusion in and beneath the sclerotic conjunctiva, is comparatively harmless; while, in the cornea, the result is usually gangrene.

3. *Heat*.—This is a symptom seldom absent or devoid of prominence. And it is easy to imagine how it should be so, when we remember that the part inflaming has an unusual quantity of blood sent through and around it; and that this blood, both while threatening to stagnate and while coursing rapidly past the obstructed part, is undergoing serious change. From this cause the temperature is necessarily elevated somewhat above its former and ordinary range, as is apparent to the touch. But nerves of sensation, partaking in the general disorder of the part, have, in consequence, their functions excited and perverted. In truth, increased sensibility is one of the signs of inflammation; and when with that we couple the circumstance of an unusual amount of changing blood giving an actual elevation of temperature, we can readily understand how the patient should feel a greater heat than the thermometer would indicate. The heat of inflammation, therefore, is partly actual, as ascertained by the touch or thermometer,* partly the result of a perverted nervous function, estimated only by the patient.

Heat, like redness—and, as we have seen, both partly depend on the same cause—to be inflammatory must be permanent. Blushing brings heat as well as colour; but both are evanescent. It is also conjoined with other symptoms of the perverted action; in hectic, there is often a constant burning in the hands and feet, yet no inflammation is there.

4. *Pain*.—Of all the symptoms of inflammation this is probably the most characteristic; yet pain is not unlikely to deceive.

Nerves of sensation, in the part inflaming, have, as already stated, their function excited and perverted; they are compressed by the distended vessels, more especially when lodged in the same fibrous sheath; and such pressure is most materially increased by the advancing effusion, particularly if this be situated in an unyielding texture. Besides, at each throbbing impulse of the blood, the arterial vessels, themselves altered in their coats, undergo, not only dilatation, but elongation; from this the *nervi vasorum* must, more or less, suffer, and they contribute something to the general amount of pain. That pressure is perhaps

* The natural temperature of the body varies from 98° to 100°, at the heart and on the trunk, and is about 92° at the extremities. In parts inflamed the thermometer has indicated a rise to 101°, 104°, 105°, and even 107°, of Fahrenheit.—(Article, INFLAMMATION, *Cyclopædia of Practical Medicine*, p. 733.)

mainly concerned in the production of the pain, may be inferred from the fact, that this symptom is invariably aggravated, and chiefly felt, when compression of the part inflamed is increased—as by the hand in peritonitis, or by inspiration in pleurisy.

Such causes are liable to vary, and so is their result. The pain of inflammation is not uniform, but influenced by the intensity of the action and the nature of the part affected. The higher and more rapid the action, *ceteris paribus*, the greater the pain. A part originally sensitive gives forth much more inflammatory pain than one naturally dull—even although under a less amount of action; an erysipelas limited to the true skin, and tending only to serous effusion, is far more painful than a suppuration of the cellular tissue. As formerly stated, pain is much regulated according to the power of yielding in the part, to accommodate effusion; inflammation of bone is more painful than inflammation of skin; erysipelas more painful than inflammation of mucous membrane; inflammation of serous and fibrous tissues more painful than either.

Pain is not always inflammatory; it may be the attendant on spasm, or on simple irritation. The pain of spasm is intensely violent from the very outset; and though often abating more or less during its stay, seldom advances to a higher degree than that with which it began. The pain of inflammation, on the contrary, usually commences with a slight amount, and steadily advances, hourly increasing, until either the action is subdued or the part has perished by gangrene. Pain of spasm is often relieved by pressure; at all events, is not aggravated thereby. In inflammation, pressure, even slight, is quite intolerable. In colic, a man is gratified by a weight upon his belly; in peritonitis, the slightest touch is torture.

In neuralgia—an example of irritation—pain is severe at its first onset, like that of spasm; it remits much and variously during its course; and often intermits wholly, during intervals more or less prolonged. The pain of inflammation may remit, but only slightly; and is never intermittent. It may disappear suddenly; but if so, is not likely to return—the part having, in all probability, ceased to be amenable to farther vital change.

The characteristics of inflammatory pain, then, are—it usually commences in a comparatively slight form, and steadily increases; it is constant, until either the action resolve or the part die; and it is invariably aggravated by pressure.

Sudden disappearance of inflammatory pain is always fraught with suspicion. It is inconsistent with its ordinary character, growing steadily as the action advances, and subsiding as it recedes. In a neuralgia, excruciating agony often ceases in an instant, for some hours is wholly absent, and then probably returns as violent as before. Such is its ordinary character and tendency; but not so with inflammation. On its abrupt cessation, we do not dream of a mere remission of its cause, but suspect, and too often with truth, that the part is no longer capable of sensation, and has lapsed into gangrene. For example, a portion of bowel is acutely inflamed, connected with hernial protrusion or not; the pain is excruciating; on a sudden it ceases, and

the patient gratefully expresses his relief, and thinks he is better, perhaps safe; the surgeon, on the contrary, is alarmed, and looks to the pulse, the surface, and the face; he finds them feeble, cold and clammy, and collapsed; the part has mortified.

In inflammation, pain is sometimes absent, or, as it were, latent. An acute abscess may have formed in a limb previously paralytic, deprived of sensation as well as motion, and the patient's attention may have been scarcely attracted to the part by the perception of aught unusual. Or an injury of a limb has been accompanied by affection of the brain, inducing coma, perhaps long continued; in the limb inflammation may be advancing destructively, yet pain is neither felt nor evinced by the sufferer. In such cases the surgeon has to feel for his patient, and in the absence of his pain, be unusually attentive to the other symptoms of local disorder.

The pain sometimes may be termed sympathetic; referred to a part at a distance from that in which the inflammation resides. Such a part is either connected intimately by function with the other; or it contains the terminal expansion of nerves whose trunks pass through or near the inflammation. Thus we may have suppuration in the hip-joint, causing infinitely less pain in that articulation than in the region of the knee; abscess of the liver producing pain in the shoulder; inflammation of the kidney causing pain at the orifice of the urethra. It is of the utmost importance that the practitioner bear this in remembrance; otherwise he may be leeching the knee, instead of the hip; rubbing the shoulder, instead of attacking the liver; looking for the outbreak of a gonorrhœa, instead of opposing a renal malady, which is soon to bring life into imminent peril.

Pain is of itself a formidable thing; if intense and constant, certain to exhaust the powers of life: and in consequence, in many inflammations, it must be overcome at whatever cost. When the part inflamed is an internal organ, intimately connected with the ganglionic system of nerves, the pain is of a peculiarly depressing nature, and highly dangerous by continuance. But ordinarily the attendance of pain on inflammation, unless severe, may be viewed rather as of a salutary tendency. Were the action painless, practitioner and patient might be unaware either of its existence or of its extent until too late to save texture, function, or even life.

When inflammation is the result of direct application of an exciting cause, as wound, heat, or acrid substance, pain usually precedes the vascular action; an immediate effect on the nerves of sensation. This may continue, more or less, and be merged in the inflammatory; or may soon cease, leaving the greater portion of the period of incubation comparatively free. Such pain is also not without its use, leading to precautionary and preventive measures—often more valuable than the curative.

5. *Throbbing*.—This is the result of obstructed circulation in the part; and will not occur, at least to any extent, until the action shall have reached the period of sanguineous stagnation. Expose the femoral artery, and its play seems even and gentle; but place a ligature around it, and on the instant the blood beats tumultuously on the distal

aspect, as if angrily labouring to overcome the obstructing cause. The inflammatory process begun, the arterial trunks in the neighbourhood are found acting with unwonted energy in bringing down the increased supply, as yet free in its course; this may be felt by the observer, and also by the patient, but is often unappreciated by the latter; the sensation of throbbing is then either absent or slight. But when there is not only an increased supply, but also obstruction to its direct transmission, a threefold energy seems to be demanded of the arteries, in bringing an unusual load, propelling it by a circuitous route, and struggling against the obstruction which lies directly in the way. Such action is felt by the patient, and that distinctly. Throbbing is thus readily accounted for in the part, and in the arterial trunks leading to it; the amount varying according to the degree of obstruction and the intensity of the action which has produced it; also modified by the texture of the part affected.

Experience teaches that, when there is much throbbing attendant on inflammation, suppuration is likely to ensue. It is easy to imagine how this should be so, in a part with its direct circulation much depressed, and its collateral much increased, effusion copious, and extravasation by lesion imminent. Throbbing, and a tendency to suppuration depend on the same cause.

Throbbing is painful; at each pulse the patient's sufferings are increased. It is then that the nerves, already tightened in their place by the circumjacent effusion, are most severely compressed; and it is then that the vascular coats, themselves disordered, are stretched as well as dilated.

6. *Increased Sensibility.*—This is the result of perverted nervous function. The eye, when sound, bears a flood of light with impunity; inflamed, it winces under the faintest ray shot directly upon it. The skin, in its healthy state, bears much manipulation; in erysipelas, the slightest touch is resented. The stomach in health neither rejects food, nor does sensation of discomfort indicate its presence; yet the same organ, becoming inflamed, is intolerant of the simplest ingesta. The bladder ordinarily awaits its full distention by urine; in cystitis, the smallest accumulation is urgently expelled.

Obviously this is also a wise and beneficial arrangement. Rest, as we shall see, is one of the most important means whereby inflammation may be met and subdued; and intolerance of function is effectual, not only to suggest the propriety of rest, but also to compel its adoption. How lamentably destructive might not inflammation prove were it unaccompanied by pain and increased sensibility!

7. *Disorder of function*, invariably attends, more or less, on the inflammatory process; the degree of disorder usually keeping pace with the progress of the action. At first, there is excitement or increase of the normal function, synchronous with simple excitement of the part; then perversion of function, corresponding with the second stage of action, when delay of the blood is begun, and extra-vascular deposit is copiously advancing. Ultimately, function is depressed; and probably arrested, in that part where the true inflammatory crisis has been attained, the blood stagnating, and structural change fairly established.

On subsidence of the action, function is resumed; but when resumed, is for some time more perverted than previous to its arrest; and may slowly if ever return to its pristine and normal character.

The stomach, inflaming, ceases to be useful as a digestive organ; the kidney, as an uropoietic; the bladder, as a receptacle of urine; the brain, as an organ of sense and intellect; a muscle or bone as an organ of locomotion; an artery or vein, as an organ of circulation; an eye or ear fails in its special duty.

Exaltation of function followed by depression is well exemplified in the case of the internal organs; the heart, or other contractile fibre, inflaming, at first acts with increased energy, but subsequently with feebleness and irregularity; in regard to the brain, we have first delirium and convulsions, then coma and paralysis; "in the early stage of inflammation of the spinal chord, there may be tetanic convulsions—afterwards follows paralysis."

But perhaps the most obvious illustration of this symptom is as respects *secretion*—say from a mucous membrane—as in a nascent gonorrhœa. At first the ordinary mucous secretion is augmented, probably in a diluted form, containing an unusual amount of serum; then it grows less copious and more glutinous, the liquor sanguinis contributing more to its formation; by and bye it changes still more, and has a puriform or milky appearance; and soon it is altogether arrested, the dry mucous lips then bearing more redness, swelling, pain, and heat than before. But true acute inflammation cannot long persist without inducing either ulceration or gangrene; the action gradually declines, and the part is moist again; at first, perhaps, blood escapes, or this may happen previous to declension; then suppuration, real or apparent; then the glutinous and the serous fluids once more; and ultimately the settling down to the ordinary mucous secretion. Or malapraxis may carry the illustration a step further, by repetition. At an early period of the disease, while matter is flowing in profusion from the orifice, an intensely strong injection is applied—not of the nitrate of silver; the discharge is speedily arrested; but the disease is not cured—for the ordinary signs of inflammation are aggravated, and the discharge now reappears more copious and inveterate than before. The action had begun to decline, but the ill-advised remedy, acting as a fresh exciting cause, brought back the true inflammatory crisis.

Extension of the Inflammatory Process.

The inflammatory process may extend, 1. *by continuity* of the inflaming texture; and certain textures are peculiarly prone to such extension—as the skin and mucous membrane. It is no uncommon thing to find an inflammation of skin, the result of injury, and at first a mere pustule, spreading continuously into an erysipelas. And perverted vascular action, at first limited to one portion of mucous membrane, often quickly spreads over a large space of the same tissue; from the fauces to the larynx, trachea, bronchi, and bronchiæ; from the pharynx to the œsophagus; from the stomach to the bowels; from the vagina to the urethra; from the urethra to the bladder.

2. By *contiguity*; the textures successively involved, not being continuous, but connected by juxta-position; and usually, the more loose the intervening texture, the greater the facility of extension. In neglected phlegmonous erysipelas, the action commencing in the surface may soon reach bone and joint; inflammation of a mucous membrane often induces abscess on its exterior, as in the case of the urethra; action, originating in the envelope of an organ, may pervade the organ itself.

The more rapid the attainment to the true inflammatory crisis in the part first attacked, the more likely is the action to extend, and that quickly, to those in the neighbourhood; its advance is unopposed by attendant change of structure. In the formation of an ordinary acute abscess, the progress is gradual, and the central portion truly inflamed is surrounded not only by serous effusion, but by a mass of dense fibrinous deposit, filling up, and as it were, fortifying the previously loose tissue, and exciting a restraining influence on both the extension of the disease and the diffusion of its products. In phlegmonous erysipelas, on the contrary, the crisis is much more speedily effected, there is no such salutary barrier, the surrounding texture remains open to both extension of inflammation, and the diffuse infiltration of matter; the consequent mischief is great and often irreparable. The limiting fibrin is either not deposited; or, as more frequently is the case, the exudation is of an aplastic kind.

Many other examples might be given of the advantage derived from true inflammation being preceded by active congestion; suppuration being surrounded and limited by plastic fibrinous deposit. Often the texture and efficiency of an internal organ are thus saved; as well as the irruption of pus into an internal cavity prevented, perilling life either by compression of some neighbouring part, or by violent inflammation of the cavity's lining membrane.

3. Extension of the inflammatory process may be *remote*—that is, the part secondarily involved is at a distance from the original site of action; and the intervening parts are unaffected. This may be effected by 1. *the blood*. This fluid, as formerly seen, emerges from the inflaming part, changed, as from a laboratory; and circulating thus altered to other and distant parts, may itself become the exciting cause of perverted vascular action there. Purulent formations—in fact, unusually acute abscesses—occurring in certain forms of phlebitis, at a distance from the affected vein, may be thus satisfactorily accounted for. 2. By the agency of the *lymphatics*. A part is inoculated by a hurtful virus, and inflammation results in the wound; besides, a portion of the virus has been carried on by the absorbents, not only contaminating the system thereby, and so establishing constitutional disorder, but lighting fresh fires in its inward track—it may be while the conducting apparatus is almost or altogether unscathed. Thus a poisoned wound of the finger gives first superficial paronychia, and then abscess of the axilla, often without apparent affection of the intervening lymphatics. When they suffer, the case is plainly an example of continuous, as well as of remote extension.

By *nervous agency*. By this, sympathy of function is maintained

between distant parts in health ; by the same agency, sympathy of action may be established in disease. Thus, morbidly as well as ordinarily, the uterus is found sympathizing with the mamma; the testicle with the urethra ; the kidney with the bladder.

Constitutional Symptoms.

But the disease extends not only from one part to another, but also from a part to the system. It seems not unreasonable to suppose that the arterial excitement, which we find so plainly marked on the cardiac aspect of an inflamed part, should extend centripetally, ultimately reaching the heart, and so induce an exaltation of the whole circulating function. But the constitutional involvement is not from mere extension by continuity, as will be immediately explained. The blood, we have seen, undergoes serious change in the part inflamed ; and by a constant succession of such changes, the whole fluid comes at length to be altered almost to the same extent as that portion of it which has just emerged from the seat of local action. Draw blood directly from the part, as well as at a great distance from it ; and the two fluids will be found exhibiting nearly the same characters of change. Its coagulation is generally slow, and results in a clot unusually dense ; surrounded by serum, apparently increased in quantity, because thoroughly squeezed out of the solid matter. In the clot the fibrin and colourless "lymph globules," increased both in quantity and in tendency to aggregation, go together ; separating from the red corpuscles, probably diminished in number, but having also their tendency to cohesion augmented ; the red corpuscles occupy the lower plane, the fibrin and "lymph globules" the upper—rendering the surface of a yellowish hue ; and hence to such blood the term "buffed" is ordinarily applied. But the increased aggregation in the fibrin not only leads to separation from the red corpuscles ; it causes contraction of the buffy layer. The contraction being centripetal, the circumference of that layer leaves gradually the sides of the recipient vessel ; the weight of the general clot at the same time dragging on the centre, a hollowing of the fibrinous surface is effected ; and the blood is said, in consequence, to be both "buffed and cupped." The coagulum is usually of the form of an oval, truncated at both extremities ; with its base broader than the top, and often adherent to the bottom of the vessel. Slightly buffed, the clot is usually cylindrical, and floating.

Such are the appearances of inflammatory blood drawn in mass. If it be taken in a full stream, into a deep vessel, exposed to warmth, these appearances are favoured : a tiny trickling stream, a shallow vessel, and exposure to cold, are, on the contrary, unfavourable to their occurrence. Also, at different times of bleeding, and even of the same bleeding, such characteristics may vary ; the portion first drawn may be neither buffed nor cupped, while that which flows last is both, and intensely so. When the blood is but slightly changed, it is said to be *sizy*.

But it is not essential to have the blood in mass. A thin film, as on a plate, exhibits a similar change. The separation between the fibrin

and colourless particles is effected laterally, instead of vertically, as in the mass; breaking up the homogeneity of the film, much more than in healthy blood, and giving it a spotted or mottled appearance, equally characteristic with the cupped and buffy coat. In a thin film of healthy blood, an appearance of speckling occurs, but only after some time has elapsed; in buffy blood, the change is immediate and most distinct. This renders us independent of form in the recipient vessel.

Further, the same information may be obtained from a drop as from a film; by the aid of the microscope,* the corpuscles are seen collecting themselves into rolls, which assume an areolar arrangement, leaving wide interspaces for the fibrin, "lymph globules," and serum. Even the eye, unassisted, observes the mottling thus caused; and so we are made independent of quantity as well as mode of abstraction. We may be very anxious to know, whether the blood will present the inflammatory characters or not; and yet the case may be one of such doubt and difficulty, as to make us very unwilling to encounter the risk of taking blood in any considerable quantity unnecessarily: such risk need not be run; a drop suffices.

But it must ever be remembered that the buffed appearance is not of itself a sure indication of inflammation. It may be seen in blood drawn from chlorotic,† as well as from pregnant females; from patients affected by sanguineous plethora, or from any one whose circulation has been much accelerated, as by violent exercise. And, on the other hand, we know that an active and most serious inflammation may be present, while in the blood the ordinary inflammatory characters can be but faintly traced. These are but the exceptions, however, strengthening the general rule. Yet exceptions all important to the practitioner; inasmuch as, while the presence of the buffy coat alone will not warrant him in reckless expenditure of blood, neither will its absence, during urgency of other symptoms of inflammation, be a sufficient excuse for withholding the lancet.

Again, both the buffed and cupped appearances vary according to the texture involved. Perverted vascular action in the fibrous tissue, as in rheumatism, invariably presents a high degree of change; while a much more formidable action may be advancing in the parenchyma of an internal organ, the change of whose blood is comparatively trivial.



* WHARTON JONES, Ed. Medical and Surgical Journal. Oct. 1843, p. 309.

† Arrangement of fibrin to constitute the buffy coat, does not depend so much on actual increase of the fibrin, as on its proportional excess over the red corpuscles. In chlorosis, the latter are very much diminished in quantity, while fibrin may be tolerably abundant.

The simply febrile condition is not capable of establishing such proportional excess of fibrin; a local inflammation must be present; that is the laboratory whence the change issues; without it, as in ordinary fever, fibrin is deficient both actually and relatively.

Inflammation of a serous membrane gives much of the buffy coat ; less will come from a higher action in a mucous expansion.

In inflammation we have thus an unusually active circulation of a deteriorated fluid ; and it need not surprise us to find the important vital organs impaired in function in consequence. All are more or less disordered ; and the state of *Fever* is established.

The first effect of a changed circulation of a changed blood, is probably on the nervous system, exerting a depressing, or poisonous influence thereon. This, again, would seem to react, also depressingly, on the circulating system ; accounting thereby for the premonitory symptoms of shivering, a pale anserine skin, lowered pulse—frequent and small—and a feeling of coldness. Soon, however, the circulation rallies, and then commence the ordinary symptoms of Inflammatory Fever. Thus, in the general as well as local symptoms of the inflammatory process, the initiative would seem to belong to the nervous system—excitement in the one case, depression in the other.

The period of incubation may be said to exist during the symptoms of depression ; but, more properly, it is considered to terminate with them ; beginning so soon as the local inflammation—the fever's exciting cause—has been established.

Sometimes the fever and local inflammations have almost or quite a simultaneous origin. It is probable that in such cases, the causes of both are the same ; system and part suffering alike, at the same time, and from the same stimulus. But usually the fever is somewhat subsequent—days may elapse, or not an hour ; obviously much influenced, if not really caused, by the changes which the local action is gradually effecting ; growing with its growth, and declining on its decay. It has been objected to such relation, of cause and effect, that fever occasionally precedes local inflammation. This is most true, but admits readily of other explanation. The antecedent disturbance of the system is a simple pyrexia, and does not assume the inflammatory type, until local inflammation has been established. Erysipelas is generally ushered in by fever ; and this fever is often present, ere there is yet a blush upon the skin ; but until the skin, cellular tissue, or both have begun to be inflamed, that fever has not the inflammatory characters ; but is an ordinary simple fever, usually dependent on disorder of the *primæ viæ*.

In inflammatory fever, there are first the symptoms of depression already noticed ; the patient feeling much discomfort, and yet unable to specify his ailment. A rigor, or fit of shivering occurs, followed by a sensation of much heat over the whole surface. This is the harbinger of reaction ; the mark—and a practical one of great importance—that the system has shaken off the temporary depressing influence, and is rousing itself into energy of action. Then it is that remedies are of most avail ; that opportunity, well taken advantage of, is usually at once decisive of a fortunate issue ; permit it to pass unemployed, and the same remedies, increased even tenfold, may fail to avert disaster.

It is convenient to consider the disorder of the general frame, according to the systems.—1. *The Nervous*. There are aching dull pains in the loins and limbs ; there is restlessness, and in much discomfort a variety of posture is practised in vain search for ease ; both the will

and the power of exertion are diminished; anxiety, or foreboding of evil, is felt, and its expression is given by the features; the head generally is hot; at first special sensation is exalted; by and bye the intellectual functions are more or less disturbed; ultimately delirium is established, and coma may ensue; the face is flushed, the eyes suffused, the skin hot and dry.—2. *The Vascular*. Disorder here is chiefly indicated by the pulse. It is increased in frequency—ranging from 80 to 130 or more; the heart's action is more rapid. It is hard, rolling like a cord below the finger, and yielding but little to its pressure; the arterial coats are exercising an increased amount of tonicity, and resist the sanguineous impulse; usually such resistance is unequally exerted at different points, causing irregularity of movement in the artery, and thus a thrill or jar is imparted to the finger. It is increased in fulness, as if the vessel were itself enlarged, and held a larger gout of blood at each impulse; the heart is acting not only more rapidly but more powerfully than in health; the circulation is truly accelerated.* Such are the ordinary characteristics of the inflammatory pulse; frequency, hardness, thrilling, fulness. The three first are seldom if ever absent; the fourth may be wanting, and the pulse small instead of full. This modification is chiefly observed during serious inflammation of important internal organs, more especially of those situated in the abdominal region; and hence it is in practice sometimes termed the abdominal pulse; the artery resembling a hard thrilling thread rather than a cord. It may be that the tonic contraction of the middle coat is unusually great; or that the ganglionic system of nerves being prominently implicated by the local action, a depressing influence is thence exerted on the heart's action; or both of these circumstances may be in operation simultaneously. But the pulse may be otherwise modified. An affection of the brain may be present; the patient may be labouring under coma; and thence will come a depressing influence on both cardiac and arterial action; the pulse will be, comparatively, both soft and slow. There are idiosyncrasies also to be taken into account; the pulse may be naturally slow or rapid—50 or 90; and this must be allowed for, when previous inquiry has satisfied us that the patient is the subject of such peculiarity.—3. *The Respiratory*. Respiration is quickened; the breath is felt hotter than usual; and an oppression is complained of in the chest.—4. *The Digestive*. The tongue may vary in its appearance. It may be either loaded, white, and moist; or loaded, white, with its edges and central tip red and dry; the latter is probably the more frequent combination. Dryness is complained of in the mouth. There is thirst, usually very troublesome; nausea, loss of appetite, sometimes vomiting, and often tenderness of the epigastrium; the bowels are constipated.—5. *The Secerning*. The secretions and excretions in general are materially diminished.† The bowels, we have

* Mere frequency of pulse is not a proof of increased rapidity of circulation; the heart's action may be weak as well as quick; it often is so, (but not in inflammation,) propelling the blood more slowly than in health. To expedite the flow, it must act not only more quickly, but more forcibly than in the normal state.

† It has been supposed that at the commencement, if not throughout, the fever, the general capillary system is in a state of contraction or spasm; like the capillaries of the inflamed part at the outset of the local action. This would account for the drying up of

seen, are constipated; mainly from want of mucous secretion from their lining membrane; the skin is hot and dry; the mouth is parched; the urine is scanty, high coloured, and acrid, but little aqueous, and holding much saline matter in solution.—6. *The Nutritive*. Digestion is interrupted, so is assimilation; the inevitable consequence is, that as the fever advances, so does emaciation, and strength is more and more prostrate.

Such are the ordinary symptoms of inflammatory fever. The more intense the action, and the more important the part involved, the more rapidly and formidably are they developed. They also vary according to the natural temperament of the patient. They may remit; nay, often do—at one time increased, at another mitigated—exacerbation usually vesperal, remission matutinal; but they never undergo an actual intermission—therein resembling the local symptoms of the malady.

Having reached a certain point of intensity, they may decline, like the local action which caused them. The pulse becomes less hard, full, and frequent; the heat and thirst diminish; strength and appetite begin to come again; and the secretions re-appear. Not unfrequently, such amendment is ushered in, if not at least partly caused, by sudden and great exaltation of the secernent function—so marked, as usually to be termed *critical*. The patient is bathed in a profuse and sustained perspiration; or diarrhœa occurs; or the urine flows copiously, more aqueous, less saline, at each evacuation less and less coloured, and on cooling, letting down a large quantity of sediment—resembling brick-dust, and hence termed *luteitious*—composed chiefly of urate of ammonia, more or less coloured by purpuric acid. Hence the state of the urine comes to be important to the practitioner; scantiness, acidity, and want of deposit denoting persistence of the symptoms; profuse flow and copious sediment, declension. Or a discharge of blood takes place, by the rectum, the urethra, the mouth, or the nose, according to the part affected. This is not unlikely to frighten the patient and his friends, and may alarm the practitioner; but the latter is highly culpable who, from such alarm, rashly interferes to stop the flow; his duty is to watch the event; withholding his hand, unless the bleeding should threaten to prove excessive. Such critical evacuations and discharges are usually preceded by rigor and exacerbation—(then, too, let the practitioner wait, and beware of officious meddling)—followed by marked relief of all the symptoms.

But these, instead of declining may advance; and, combining persistence with intensity, may cause a fatal result. Protracted exercise of a muscle ultimately exhausts the irritability of that muscle, which then ceases to obey the stimulus. In like manner, the excitation of the general system is certain, if both great and prolonged, to wear out the powers of that system; and the patient sinks in consequence.

Or the symptoms neither simply decline, nor simply advance, but undergo change. 1. On the occurrence of suppuration, profuse and

secretion, and also assist in explaining the tumult and labour of the general circulation.—ALISON, *Outlines of Pathology*, p. 138. The want of secretion and excretion, from whatever cause directly arising, obviously tends to maintain the oppression of the heart and arteries, by, as it were, shutting the door to the ordinary means of relief.

long-continued, or in an internal and important organ, or in a patient previously much debilitated, they change their character, and are termed hectic fever. 2. On the occurrence of mortification, extensive, in an internal and important part, or in a worn frame, they change to the typhoid form, tending to fatal collapse.

Causes of Inflammation.

The causes of inflammation used to be divided into, 1. Predisposing; 2. Exciting; 3. Proximate. But as the last is really the thing itself—the nature and phenomena of the action, already considered—we have to do only with the first two.

I. *Predisposing*.—These may act through the general system, or directly on the part itself, or in both ways. 1. *Unwonted excitability*, may reside in a part or in the system, by exaltation of the nervous function. When occurring locally, it manifestly predisposes to inflammation, whose first movement is an impression made on the nerves by the exciting cause. By strained use, for instance, the eye has its sensibility exalted, and the induction of ophthalmia so favoured. 2. *Plethora*, may be general or local. The former—either the result of original temperament, or casually induced, as by excess in diet—may, by the abundance of material which it supplies, favour increased flow of this to any particular part, and so facilitate the induction of inflammation; but it is probable that it does not act so often or so much in this manner as is generally supposed; the blood itself is not predisposed—its red globules are in excess, not the fibrin. But there can be no doubt that local plethora—that is, determination of blood to a part—however induced, predisposes, and that strongly, to inflammation—whose first movement, after the nervous impression, is this very sanguineous determination. Increased and sustained use of a part—as of the eye, kidney, liver—both heightens its sensibility, and brings to it a determination of blood; and thus doubly predisposes to inflammation. It is familiar to all how every organ thus exercised is prone to be inflamed. It may be farther observed, that local plethora, with the disposition to perverted vascular action which it engenders, has an important relation to age. In infancy and childhood, the brain is peculiarly liable to suffer; in adolescence, towards puberty, the pulmonary organs; in the adult, the abdominal. 3. *Debility*, general and local. This is by far the most prolific class of predisposing cases. A vital power or strength resides inherently in the system, and in parts of that system, whereby morbid action, resulting from the application of an exciting cause, is either resisted successfully and averted, or, when commenced, is controlled and modified. The greater the impairment of this vital power, the more prone are system and part to the occurrence of disease. Inflammation thus often predisposes indirectly to inflammation. A part inflamed, we formerly saw, has its vital power impaired, and never wholly regains it; it remains weak, and consequently predisposed to recurrence of the action; sure to be overcome by even a slight exciting cause, whose stimulus it could previously have borne with impunity. Bad food, air, and clothing; intemperance;

excessive and habitual exertion of mind or body ; excessive and habitual evacuations ; previous disease, and often the treatment necessary for its removal—are familiar examples of causes of debility, and consequently of predisposition to inflammation.

The predisposing causes may be combined. An eye, for instance, may have a determination of blood towards it, at the same time that its sensibility has been exalted by unwonted exercise of function ; at the same time, by a previous inflammation, the part is weak ; and by confinement, bad air or food, sustained mental exercise, or all together, the frame also is debilitated. A part thus unfortunately situated can scarcely avoid a high and injurious action.

II. *Exciting*.—Those which directly induce the morbid action. The more prominent may be shortly mentioned in detail. 1. Ordinary irritants ; as acids, alkalis, many salts, alcohol, turpentine ; acting by direct stimulus on both nervous and vascular systems of the part. 2. Wounds, and other mechanical injuries, require a certain amount of vascular action for their cure ; not unfrequently that action is by circumstances carried beyond what is simply salutary, and prolonged into true inflammation ; suppuration is established, and the process of healing delayed until the action shall have again subsided from the inflammatory acmè. 3. Lodgement of foreign bodies. A wound is not unlikely to inflame ; but if it contain extraneous matter, which is not removed, inflammation is inevitable—the result of prolonged application of stimulus. 4. Pressure, in like manner, is a prolonged stimulus ; if slight, the absorbent system may be chiefly excited, causing simple absorption ; if severe as well as sustained, the nervous and vascular suffer as well—inflammation is produced, and may cause true ulceration or even gangrene. 5. Heat is a most powerful agent. Extreme, it may at once reduce the part to the form of a dead eschar : applied more leniently, it proves a stimulus to both nerves and blood-vessels, inducing perverted action of the latter, varying from simple excitement to the most intense inflammation. 6. Cold, considerable and sustained, may act, as an excitant of inflammation, either on the part itself, whose temperature is diminished, or on some other at a distance. (1.) At a distance. Cold is applied to the feet and legs, or to a large part of the general surface. Circulation is enfeebled there, as shown by the pale and shrunken integument. The blood, instead of being equably distributed over the body, is pent up within, and overloads the internal organs ; one of these—the lungs, for example—is more burdened, or more susceptible than the others ; it has obtained the first vascular move for inflammation ; that process is begun and advances. (2.) On the part itself ; not by the first effect of the cold, but by reaction following upon this. While decrease of temperature is maintained in the part, comparatively little blood circulates therein, its nervous influence is depressed, and all vital power, as well as action, is enfeebled. On withdrawal of the cold's influence, blood rushes back to the comparatively empty capillaries ; nervous agency is restored with a tingling ; simple vascular excitement, or in other words, the first stage towards inflammation, is at once established, and that in a part whose vital power has just before been impaired, and which, consequently, is but

little able to resist or control the action so commenced; this advances comparatively unopposed, and the part may fall an easy prey to inflammation. The onset of inflammation will of course be more rapid and severe, if the cold be not merely removed, but heat, friction, or other stimuli, at the same time applied; nothing can be more injudicious, yet there are few practices more common; grave inflammation is rendered inevitable. 7. Atmospheric change, may either predispose or excite; the former, when the exposure is general and habitual—usually associated with habits of intemperance; the latter, when exposure is partial and sudden. It is familiar to all how often inflaming throats, eyes, lungs, and joints, are attributable to casual exposure to atmospheric vicissitude; the *modus operandi* is similar to what has just been explained in regard to cold. 8. Undue exercise of function, in like manner, may either predispose or excite; according as it is moderate and habitual, or casual and excessive. It operates by inducing local plethora, at the same time exalting sensibility; not only inviting the action, but giving the first move in its advance. 9. Vitiating secretion acts as a direct chemical irritant; (1.) from one part to another, in the same patient, as tears to the cheek, discharge from the rectum and vagina to the cleft of the nates; (2.) from one patient to another, as gonorrhœal discharge from the urethra acting on the conjunctiva; (3.) from the lower animals to man, as in the case of the vaccine virus. 10. Retention of the ordinary secretion of an organ, tends to inflammation; retention of urine may be followed by cystitis; distention of the lachrymal sac, by fistula lachrymalis. Secretion, when healthy, is no stimulus to the part; but, changed in quantity, quality, or in both, it may become so.

Inflammation may occur without any apparent or assignable exciting cause. It is then said to be spontaneous or idiopathic.

Duration and Character of the Inflammatory Process.

Generally speaking, rapidity of progress and intensity of action are phrases nearly synonymous. Sometimes the process is very gradual in its advancement; requiring, as in the example of the vaccine pustule, formerly adduced, eight or nine days for its completion; and many actions are yet more protracted. After a wound, or other mechanical injury, the process is usually complete, and suppuration established, by the second or third day. One day, or less, suffices for the occurrence of suppuration in many cases of phlegmonous erysipelas. And the secondary abscesses attendant on phlebitis, there is every reason to believe, are begun and completed within a very few hours.

Progress varies, as to time and character, according to, 1. the *structure* of the part affected. The more highly organized, vascular, and endowed with nervous energy, the more rapid and sthenic the action—*cæteris paribus*. 2. *Situation* of the part. The nearer to the centre of circulation, the more disposed to rapidity and extent of action. 3. *State* of the part. When vital power has been impaired, by previous inflammation or other debilitating cause, the part is prone to assume morbid action, and this invariably tends to a speedy and unfavourable issue.

All adventitious structures, also, being of low organism and vitally weak, soon yield before inflammation. 4. *Temperament* of the patient. The sanguine favours both rapidity and intensity; in the nervous, action is readily induced, but is prone to assume the asthenic and chronic form; the phlegmatic is unfavourable to occurrence, rapidity, and intensity. 5. *Diathesis* plainly modifies action both in its occurrence and character; as is exemplified in the scrofulous and rheumatic inflammations. 6. *Age*. In childhood and infancy, vascular action is both likely and acute; often its progress is fatally rapid. In adolescence, its general character is also acute, easily induced, but not apt to tend disastrously, there being usually enough of vital power to maintain control; then too, by reason of habitual activity in the nutritive function, action is usually attended by copious exudation of the more solid kind, either fibrinous or albuminous, (plasma or tubercle,) according to the power and disposition of the system. In adult life, action is probably less easily induced, but is usually acute and sthenic. Old age is more prone to passive congestion; when the inflammatory process does occur, it is generally languid, slow, and tends to an unfavourable result; for both part and system are lowered in vital power. 7. As regards *Sex*; females are constitutionally prone to inflammations; but males are more exposed to casual predisposing and exciting causes; the latter sex too, may be considered as pre-eminently liable to action of an acute and sthenic type. 8. *Habits* of intemperance predispose to inflammation, rapid, intense, and apt to end injuriously. Sedentary habits are also favourable to accession, but usually the action is more under control. Privation—involuntary or assumed—is unfavourable to accession; and action is usually chronic and asthenic. 9. *Atmosphere and Season* are related to inflammation, not only as important predisposing causes, but also as materially influencing its progress and type. An evil atmosphere impairs the vital power, and so favours the onward progress of morbid action to a rapid and unfavourable issue. In like manner, an unhealthy season fully vindicates its title to the name by its subtle and sinister influence on inflammatory as well as on other forms of disease, as the history of erysipelas, especially when epidemic, abundantly testifies.

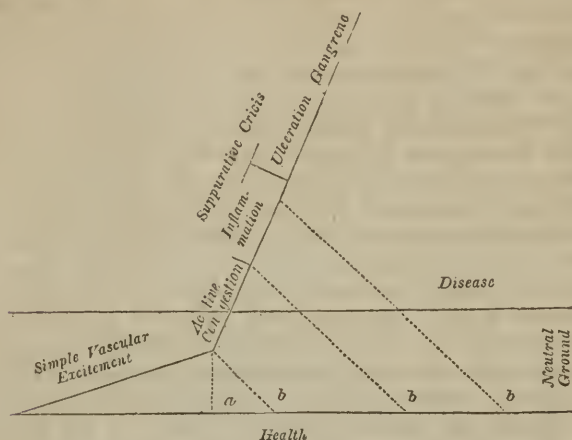
RESULTS OF THE INFLAMMATORY PROCESS.

I.—*Resolution*.

This is the most favourable result, and that to which treatment is usually directed. But, let it never be forgotten, that such treatment must be early, as well as suitable and active; inasmuch as this result can only be hoped for while the action is yet beneath the inflammatory acmè. That reached, true resolution—that is, restoration of the part as regards both structure and function, to its original and normal state—is impossible.

The accompanying diagram, though both rude and fanciful, may

assist to make this more plain. It will also illustrate the opinion held as to the gradual formation of the true inflammatory crisis.*



The commencement, not inconsistent with healthy structure and function; its consequences usually salutary; but sometimes, by persistence, injurious. The second stage, a departure from true health, and pressing on to true disease; the consequences sometimes salutary, in local emergencies; but in general prone to evil by alteration of both structure and function. The third stage essentially morbid; utterly at variance with healthy structure and function. The higher results, which follow on the crisis by continuance of the action, are invariably subversive of function, and destructive of texture; and, consequently, pernicious, unless when it has become essential for the well-being of the whole that the part so affected shall be removed.

Resolution may be gradual or sudden, spontaneous or artificial, imperfect or complete; the more early and slight the action, the more likely is the resolution to be rapid, spontaneous and perfect.

When sudden, the term *Delitescence* is commonly employed; denoting a circumstance favourable in itself, but invariably coupled, in the mind of the experienced practitioner, with a suspicious prognosis. Were the delitescence simply effected, and there an end, the immediate benefit derived would be unmixed. But experience tells us, that the abrupt and sudden disappearance of advancing vascular action in one part, is often, if not usually, followed by the appearance of similar disorder elsewhere. And as we have no guarantee that the change shall be to an equally harmless locality, such change must at all times be a matter of suspicion, and generally of danger. Inflammation, for example, may leave one part of the skin, and suddenly re-appear in another portion of the same tissue. Or the action may quit an internal part, and show on the surface. In the one case, probably no harm is done; in

* The dotted lines denote the process of resolution, or the return to health—*a*, sudden and direct resolution, or delitescence. *b, b, b*, lines of gradual resolution from various points of the ascending action.

the other, a decided advantage accrues from the change. But, on the other hand, delitescence of an erysipelas is often followed by establishment of the inflammatory process in a serous or mucous membrane, or even in the substance of an important internal organ; and such change may be—has been—fatal. The process effecting subsidence of the original action, and establishment of the new, is termed *Metastasis*.

Metastasis may be only apparently. Often disappearance of an external inflammation is quickly succeeded by supervention of an internal; and the latter is rightly held related to the former, as effect to cause. Yet not unfrequently we may have the two circumstances contemporaneous or nearly so, with their relation reversed; the internal disorder proving the cause of the subsidence of the external—the less merged in the greater malady.

Resolution being about to occur, increased effusion probably takes place; of serum, liquor sanguinis, or both; by this means, amongst others, the burdened vessels are more or less relieved; they recover their wonted tone and calibre; and circulation revives from the impending or actual remora. The red corpuscles resume their individual distinctness, and the agglomerate masses of both red and colourless corpuscles first oscillate, and then move steadily on. Sometimes, however, the colourless corpuscles remain adherent in unusual numbers to the walls of the vessel; for a time, at least, diminishing the stream. The local determination of blood ceases; and the inflammatory changes begun in that fluid are recovered from. Absorption, which had been embarrassed hitherto, or altogether held in abeyance, comes actively into play; and the effused liquids are more or less rapidly removed—the more rapidly, the more serous their character. Ultimately an equality of action is arrived at between effusing blood-vessels and removing absorbents; the balance of healthy nutrition in the part is restored; and normal function is resumed.

Such change is marked by a corresponding alteration, equally favourable, in the local symptoms. The pain and heat are the first to subside; then the redness; ultimately the swelling, more or less gradually, disappears. Should the constitution have begun to sympathize, the fever will be found to decline, as formerly described.

When the inflammatory process has been slow in its advance to the resolving point, as well as in its subsequent declension, resolution will probably be imperfect; for thus time has been afforded for the fibrinous deposit to assume a solid and organized form, less amenable to absorption than when of the fluid or semifluid consistence which obtains shortly after exudation. There is an obvious risk consequently of a certain change of structure either proving altogether permanent, or long resisting the efforts of the absorbents.

Should the true inflammatory crisis have been closely approached, a certain loss of vital power will be permanent in the part, even after change of structure has been apparently altogether recovered from.

II.—*Excessive Deposit, by Exudation through the Vascular Coats yet entire.*

This attends on the advance of the process, and also persists, though to a diminished extent, during part of its decline. It may be serous, fibrinous, or both.

1. *Of serum*, containing more albumen, and of higher specific gravity than in health.—This, in combination with other effusion, attends on the whole range of the inflammatory process; and is usually situated circumferentially. Occurring singly, it is the product of a low degree of action; and, as already stated, may be considered appropriate to the first stage of the process.

(a.) It may be effused in the *interior* of the part; occupying the fibro-cellular tissue, and constituting *Acute Œdema*. The attendant symptoms are pain, heat, and redness, proportioned to the amount of action; the swelling varies according to the extent of effusion, and nature of the recipient part; if the latter be unyielding, tension ensues, with increase of pain and acceleration of the action onwards; but usually the surrounding textures are accommodating, the swelling is found soft when compared with that of fibrinous character, and, yielding before the finger by temporary displacement of the serum, is said to *pit* on pressure. The pitting, however, is much less distinct in the Acute than in the Chronic Œdema, to be afterwards described.

(b.) The serous effusion may be from the *surface* of the part; whence it flows harmlessly away, as does the ordinary secretion in health—as in the case of inflaming mucous membrane. Or it accumulates within an internal cavity, as those of the serous membranes; then constituting *Acute Dropsy* of the part; the bulk, uneasiness, and disturbance to healthy function by pressure, varying according to the extent and rapidity of effusion.

Acute effusion of serum, whether in the form of œdema or dropsy, usually disappears soon after decline of the action which produced it, by the resumed and increased play of the absorbents. Herein, again, practically most different from the result of Chronic Congestion.

2. *Of Plastic Fibrin*.—This may be exuded by itself, separate from the serum; but more commonly with the serum, in the form of liquor sanguinis, or coagulating lymph; the latter term denoting its peculiar property of assuming the solid form by coagulation, when extra-vascular. It is the result of a higher degree of action than the purely serous effusion; and, as formerly stated, may be regarded as the characteristic product of the second stage of the inflammatory process, Active Congestion.

(a.) It may take place on the *surface* of the part; as on a serous membrane, or on the margins of a wound. On coagulation, the serous portion trickles away; the fibrinous remaining, in the form either of a continuous film, or of masses more or less detached; at first transparent, afterwards becoming yellowish, and somewhat opaque. Should the action now subside, the absorbents find the effusion quite amenable to their renewed play; and they remove it. But if the action persist, and

yet not have reached the inflammatory crisis, absorption does not take place, and an opportunity is given for organization of the deposit. The fibrinous mass or layer separates to form the rudiments of organic structure, viz. fibrils and exudation corpuscles; according to the general law to which such fibrin is obedient, that, when effused from, and remaining in contact with a living texture not truly inflamed, it has a strong tendency towards self-organization, assuming the simple structure of fibro-cellular tissue. It is consequently termed *plastic*, or *euplastic*, according to the facility and efficiency with which such structure is assumed. - The fibrils, sometimes parallel, usually cross each other in various directions, forming an interlacement, in the meshes of which are the corpuscles. These latter are at first an aggregation of granules and molecules, in detached forms, termed "exudation corpuscles;" subsequently they change into the form of the rudimental cell, with central nucleus. Perhaps the action now subsides; and still the effusion is liable to be absorbed; but it is probable that, previous to absorption, and auxiliary to that process, the organic formation is undone, and the fibrin reduced to a fluid or semifluid consistence, as in the ordinary absorption of decayed original texture.

Failing absorption, and the action proving still short of True Inflammation, the organic arrangement remains, the basis of a new texture. But, in order to insure permanence and perfection of structure, it is expedient that it be supplied with blood and blood-vessels. Accordingly the process of Vascularization is commenced. Blood corpuscles are seen coursing each other through the plasma, in new blood-vessels, coming from, and again returning by, the vessels of the adjacent original structure. According to some, these new vessels are, as it were, self-formed in the plasma. Nucleated cells arrange themselves linearly, elongate, and communicate with each other by decadence of the opposing surfaces; and the central nuclei first oscillate in the channel or tube thus formed, and then, receiving an undeniable impetus *a tergo*, by the heart's action, communicated through the neighbouring original vessels, they push onwards, and enter the general circulation, their place being supplied by blood corpuscles escaped from adjacent capillaries. Thus a canal is formed, continuous with original blood-vessels on either aspect, and circulation established within it. Or, according to other physiologists, blood corpuscles escape, few in number, from the adjacent original vessels—oscillate in the plasma—then push across and join the return veins; and a new canal having been thus opened up, these first, or "pioneer" corpuscles are succeeded by others in a continuous stream, insuring the patency of the canal, and establishing its circulation. And from such parent canal, or canals, divaricating tubes of a similar kind are channeled out by a similar process. Both theories may be true; new vessels may be formed, now in the one way, now in the other. To the practical surgeon, the question is of comparatively little moment. In whichever way formed, the new capillaries are at first anormally capacious, larger than the vessels which supply them; "they are afterwards contracted by the formation of a basement membrane lined with epithelium."

Thus far advanced—endued with an organic arrangement, and sup-

plied with blood-vessels, in which blood is actively circulating—the plasma is now capable of assuming a higher degree of organization, and in due time comes to resemble the original texture (with some exceptions,) from which it was effused—a process of change mainly attributable to transformation of the nucleated cells. Be it remembered, however, that this process is incompatible with the co-existence of true inflammation, according to our acceptation of that term. Wherever this occurs, the fibrin is aplastic; it never reaches higher in the range of organization than the exudation corpuscle; thence degenerating into the pus globule, it is associated with the serum of the liquor sanguinis, from which it had just separated, to constitute purulent matter. And such degeneration will be continued so long as true inflammation persists. It is only after subsidence from the inflammatory acmé, that some of the fibrin becomes organized—as in the case of granulation—a portion only, instead of all, being then thrown waste in the shape of pus.* True inflammation, however, may be, and usually is, *surrounded* by a less degree of action, giving rise to plastic fibrinous effusion; and hence we find, as formerly stated, the purulent formation usually encircled, and happily limited, by a barrier of fibrin more or less advanced in organization. But should the action disregard that barrier, establishing itself where active congestion only had hitherto been, the fibrin ceases to be plastic: and, besides, that which had been previously effused, to construct the barrier, has its advancing organization not only arrested, but broken up and undone.

Fibrin, more or less plastic, effused on the free surface of a membrane, is usually termed *false membrane*, assuming a structural arrangement, in the first instance, resembling that of the buffy coat of the blood, and forming a layer or coating somewhat similar to the original and invested tissue; when accompanied by purulent or sero-purulent secretion, as it too frequently is—an indication of true inflammation; but when either alone, or attended by effusion simply serous—showing the presence of an amount of action short of that which is truly inflammatory. When of truly inflammatory connexion, as indicated by the co-existence of purulent or sero-purulent effusion, it is usually of low organism; and to be regarded as analogous, not to the simple adhesion of a wound, but to the partially organized fibrinous exudation which precedes and limits the purulent secretion in an ordinary abscess.

(b.) Fibrin may be exuded in the *interior* of the part; and being at first fluid, insinuates itself to fill up every minute space, occasioning enlargement; cohesion is generally impaired. If the action be acute, the part is softened as well as swoln, a considerable proportion of serum being mingled with the fibrin; and on the exterior of the fibrinous range, is found a more extensive one of serum alone. If the action be slow and gradual, induration is found instead of softening; the serum having been absorbed, besides in all probability having been

* The opinion that a minor degree of action is most favourable to organization and vascularization, and more especially to vascularization, is strikingly corroborated by an excellent paper by Mr. J. Dalrymple—"On Rapid Organization of Lymph in Cachexia."—*Medico-Chir. Trans.*

sparingly effused at first; the fibrin also has had full time to assume the solid form, and is more or less advanced in organization.

If the action continue, in a chronic and subdued form, the deposit becomes fully organized and vascular; and being now little amenable to absorption, a serious change, more or less permanent, is thus effected in the structure of the part; it is indurated, thickened, and enlarged. And should such action persist, causing continuance of plastic deposit in greater abundance than absorption can normally control, the enlargement and change of structure gradually increase, giving rise to the simplest form of tumour. The action ceasing, so does redundancy of deposit; the absorbents then busy themselves in attempts to clear away what has been already heaped up, and in this good work they may often be materially assisted from without by the hand of the practitioner.

(c.) The effusion may be *both on the surface and in the interior*; for instance, into the texture and on the exterior of a serous membrane; or on the surface of such a membrane, and into the parenchyma which it invests. The result is a combination of the changes described in the two preceding sections of this subject.

Thus we see that fibrin, effused during the inflammatory process, undergoes various changes, according to the grade of action by which it is accompanied. It may be absorbed; resolution. Or it remains and becomes organized; by persistence of the first stage of action, or of the second in a subdued form. Or it degenerates to form pus; the true inflammatory crisis having been attained.

Inflammation having been reached, organization ceases; on the subsidence of the action to a minor grade, it may again advance. But to all fibrin so organized, a general rule seems to be applicable, viz., that it is of low or imperfect organism, and, by consequence, liable to destruction in one of two ways; either by simple absorption, on subsidence of all perverted vascular action, or by a secondary accession of such action advancing to suppuration and ulceration. This is favourable; as regards the discussion or disintegration of simple enlargements of inflammatory origin. Unfavourable, as regards reparation of solutions of continuity; and hence it is that the cicatrix by granulation—a process always preceded by true inflammation—is often undone, and the wound made gaping as before, while union by adhesion or by the slow “modelling process,” into whose composition true inflammation does not and cannot enter, remains firm and enduring.

It is only, then, the *non-inflammatory* exudation of fibrin which is thoroughly euplastic. By it wounds unite, bones knit, and arteries are consolidated. These salutary processes are wholly incompatible with true inflammation; and often are but ill-performed after its subsidence.

Inflammation is essential—or indeed useful—towards reparation, only when the liquor sanguinis, by reason of debility in the part, is deficient in fibrin; as in an old and indolent ulcer. An invariable effect of the inflammatory process, we know to be a marked augmentation of that plastic substance. It will bring an additional and probably sufficient amount of reparative material to the part, therein before defective; but such fibrin is not capable of due reparative application,

until the action which brought it has subsided from the true inflammatory crisis. Even then, as just stated, organization proceeds at a disadvantage; but organizable fibrin of the second class—that which is unconnected with true inflammation being of the first—is better than none at all.

The inflammatory process increases the facility and rapidity with which fibrin assumes an organic arrangement; but the arrangement assumed is apt to be imperfect and of low type, when contrasted with that which is thoroughly of non-inflammatory connexion.

III.—*Inflammatory Hemorrhage and Extravasation.*

When the process has approached the true inflammatory crisis, we have seen that the altered vascular coats are apt to give way, permitting the contained blood—liquor sanguinis and red corpuscles, in mass—to escape more or less copiously. If this occur on the surface, the accident is termed Hemorrhage; if in the interior, Extravasation. The former most frequently takes place in inflaming mucous membrane, the blood escaping by the mucous outlet; and is not to be rashly checked, inasmuch as it generally tends towards a beneficial result. The implicated vessels are not only relieved of part—it may be the greater part—of their burden; but a general resolutive effect may be obtained, as if the flow were an artificial one from a vein at the bend of the arm. In such cases, a practitioner suddenly called must take care not to suppose that to be of itself a disease, requiring immediate arrest, which is actually a means of cure directed against advancing inflammation—requiring to be watched, perhaps favoured, but only to be arrested when threatening to prove excessive.

When, however, the hemorrhage takes place into an internal cavity, it cannot be too soon arrested, and we would rather prevent it altogether if possible; seeing that its presence, bulk, and pressure, may excite action of a still higher grade, or seriously interfere with the function of neighbouring viscera. In the chambers of the eye, for instance, extravasation may hurry on action to ultimate disorganization of the eyeball; in the cavity of the peritoneum, peritonitis may be hopelessly aggravated; in the pericardium, the heart's action may be fatally overborne; in the membranes of the brain, coma by compression is established.

Extravasation is seldom but injurious, and therefore at all times to be avoided. Occurring in an internal organ, it occasions serious consequences, not only by arrest or impairment of function in that part itself, but also, perhaps, in others adjoining, by pressure made on them. Occurring externally, it is unfavourable, as indicating a high grade of action, breaking up texture, and paving the way for suppuration.

IV.—*Suppuration.*

True inflammation is essential to the first formation of pus; but, once formed, a less amount of action is sufficient to maintain the secre-

tion. It has been objected that purulent collections are formed in the latter stage of phlebitis, too rapidly to admit of precedent inflammation; such occurrences, however, will be afterwards shown to be no exception, but corroborant of the general law here laid down.

Suppuration, originated by true inflammation, and maintained by a minor grade of action, will probably be arrested for a time by re-induction of the true inflammatory crisis; according to the general law, whereby such action arrests secretion in general. For example, during the early stage of gonorrhœa, profuse purulent discharge having just set in, a strong stimulant injection may be employed, giving much pain; the part dries up; only, however, again to break out with increased intensity, so soon as the second acmè of inflammation has begun to give way; in fact, this may be said to partially resolve itself by a renewed and increased effusion.

Pus may be regarded as a changed condition of the liquor sanguinis, consisting of globules, and small molecular particles, more or less numerous, contained in a thin serum. The serum is analogous to that of liquor sanguinis, the globules and molecules to its fibrin; indeed, there is every reason to believe that the globules are actually fibrin in a degenerated form. The formation may be either intravascular or extravascular—that is, pus may be formed more or less perfectly within the vessel, and separated from it as a secretion, as we observe in inflamed mucous membrane, and in the granulative structure; or the purulent change may be entirely subsequent to effusion. In the latter case, the process would seem to be as follows:—Liquor sanguinis is effused; it separates into serum and fibrin; the latter, coagulating, assumes the solid form, at first uniform and unbroken, then in granules; granules change into exudation corpuscles, approaching the cellular form, but instead of attaining to the organized condition of true nucleated cells, they degenerate and become the pus globules and molecules; these mingle with the serum from which they had so recently separated, and imparting to that fluid a whitish colour and opaque consistence, constitute pus. This resembles cream in consistence and appearance; opaque; yellowish-white or greenish, insoluble in water, but readily mixing with it; heavier than that fluid, the specific gravity varying from 1030 to 1040; coagulable by muriate of ammonia; not prone to putrescence; of a “sweetish and mawkish taste;” emitting scarcely any peculiarity of odour when newly and simply formed, but contaminating the air much and noisomely when either connected with carious or dead bone, or allowed to accumulate and remain in quantity.

It is not a corrosive liquid, as the ancients imagined, but bland and protective; tender granulations, for instance, are invested with it, for the express purpose of protection, and that effectually, until covered in by cuticular formation. It is true, that when “cribbed, cabin’d, and confined,” in the interior of a part, it induces disintegration of those textures with which it is brought immediately in contact, not, however, by erosion, but by the pressure of its accumulation; such pressure inducing absorption, ulceration, or both.

Nor is its formation a chemical process, as at one time imagined—a melting down of the solids, by putrescence, as the name of *pus* (*πυω*)

implies. It is essentially a vital action, quite as much as the secretion of an ordinary fluid, say the serous or mucous; only the one is the product of healthy, the other of morbid vascular action. As the inflammatory process approaches the completion of its third stage, we saw that there was increased and almost complete remora of the blood, copious fibrinous effusion, extravasation of blood by giving way of the altered vascular coats, with consequent breaking up of normal texture; and that in the part so affected the formation of pus then speedily occurred, the pus occupying the place of the disintegrated original texture. It is a perversion of the liquor sanguinis, partly intravascular and partly subsequent to effusion. When elaborated within the vessel, it may be more or less copiously effused therefrom, as ordinary liquor sanguinis would. In the latter case, as already stated, it is believed to consist of the following successive changes; 1. liquor sanguinis effused in a part, the seat of the true inflammatory crisis; 2. its coagulation or separation into serum and fibrin; 3. the granules of the latter form exudation corpuscles; 4. these degenerate into pus globules, which, along with small molecular particles, furnished from the granules, mingle with the serum, and form pus. To the completion of such change, the contact of atmospheric influence is decidedly favourable. On subsidence of the action from its acmè, the whole of the effused fibrin does not thus degenerate; the amount of action is no longer incompatible with the plastic function; part of the fibrin remains adherent to the original tissue, and gradually becomes organized; and thence and thus are constituted the granulations of an open suppurating surface, and the limiting cyst of an internal abscess.

The essential point in the formation of pus, then, is the presence of actual and true inflammation; and the peculiarity of its constitution is the presence of the globules and molecules. These molecules are small rounded particles of fibrin, some floating loose in the serum, others contained within the globules. These latter are thin cells, containing fluid and a greater or less number of molecules, and sometimes with granules of fibrin attached to the exterior. They are rougher on the surface and more truly globular than the blood disc; the greater number are also larger than the blood disc, and altogether they are more varied in size, the average diameter probably $\frac{1}{20000}$ of an inch. They have little power of cohesion among themselves, and "in proportion as they predominate they impair the consistence of fibrin or mucus with which they are combined." Probably it is to the infiltration of pus that the inflammatory softening of texture—termed, in regard to the nervous tissue, ramollissement—is attributable.

Pus, as we have described it—the result of vital action—is of normal character, and usually termed healthy, or *laudable*. But various circumstances may cause deviation from this. A chemical action may be superadded to the vital; probably the agency of atmospheric contact, producing hydrosulphate of ammonia by decomposition of the albumen of the serum, whose presence is indicated by offensive odour and by the blackening of silver probes brought in contact with the fluid. Putrescence may be thus begun in the fluid while it is yet in contact with the living part. Disintegration of the surrounding texture, by ulcera-

tion, is often co-existent with the formation of pus; it will then be mingled with the fluid debris of the part, and consequently more prone to chemical change. Or it may be mixed with blood, either fluid or solid, reddened thereby, and found to contain blood discs or masses of coagula; and, accordingly, termed sanious or grumous. In those of weak systems, it is often deficient in solid matter, consisting chiefly of a thin serum; it is then termed serous. In the scrofulous, it is often not only serous, but mingled with flakes or masses of broken down tubercle, giving more or less of a curdy appearance; to such the term scrofulous is usually applied. Sometimes it is impregnated with a subtle virus, as the venereal or vaccine; it is then said to be specific. Further, it may be variously mixed with secretions from mucous and serous membranes, and termed in consequence sero-purulent and mucopurulent.

Coagulated blood, undergoing a peculiar process of decomposition, becomes liquid, and this fluid closely resembles pus in appearance; but the researches of Mr. Gulliver have clearly shown that it is not true pus, only its counterfeit.

Pus may be formed on the free surface of a part, and be thence discharged; or in the interior of a part, and lodge there. In the latter case, the immediate effect of suppuration varies according to the nature of the part. If loose and extensible, as is ordinary cellular tissue, often the pain and throbbing cease, or, at all events, diminish, and the swelling becomes paler, soft, and fluctuating; if, on the contrary, the texture be dense and unyielding, as the osseous and fibrous, the general inflammatory action, with its indications of tension, redness, heat, and pain, is much aggravated. The result also depends on the form of action which has preceded. If it have leisurely advanced through its successive stages, the pus is not secreted ere a barrier of plastic fibrin has been formed, to limit it, and protect the surrounding parts, as in the ordinary abscess. But if a rapid transition have been made from the origin to the acmè, no fibrin is interposed—either it is not exuded, or, rather, the exudation is wholly aplastic—the pus is infiltrated diffusely into the neighbouring tissue, breaking it up, and causing its destruction by ulceration and gangrene, as in phlegmonous erysipelas.

We have just seen, that on the occurrence of suppuration the symptoms of the local inflammation sometimes subside, sometimes become aggravated. A change also usually takes place in those of the general inflammation, or inflammatory fever. It was ushered in by a rigor; and the same phenomenon usually indicates the approaching change. The inflammation continuing, the fever may continue also; it may increase with the inflammation's increase, or subside with its decay. Usually the rigor is followed by a marked remission of all the febrile symptoms; and this remission either continues until resolution is complete, or is superseded by the accession of febrile action of another type, termed *Hectic*. And this latter is sure to occur, when the suppuration is profuse and long-continued, when the patient is of an already debilitated frame, or when it occurs in an internal organ important in the animal economy.

This fever is a form of *Constitutional Irritation*, widely different from

the inflammatory type; and may be produced by other circumstances besides mere suppuration. Its general character is decidedly remittent, more especially when contrasted in this respect with the precedent inflammatory fever. Its ordinary symptoms are, a general paleness of the surface, excepting the cheeks, on which there is usually a delicate and circumscribed bloom; beautiful, yet a strikingly morbid indication —“like the unnatural red which autumn paints upon the perish'd leaf.” The appetite is resumed, and sometimes apparently digestion also; the former is sometimes inordinate; but yet emaciation sets in and advances, sometimes with great rapidity. The tongue is preternaturally clean, especially at the tip and edges; at first moist, but ultimately becoming dry and glazed, and perhaps studded with aphthæ. The condition of the bowels varies, but constipation usually predominates, until the fever's extreme has been attained, when obstinate diarrhœa, termed colliquative, is established. There is thirst; and burning heat is much complained of in the cheeks, soles of the feet, and palms of the hands; the general skin, at the commencement, is both dry and warm, but soon shows a tendency to profuse perspiration, totally ineffectual however in resolving the disease. Respiration is rapid and short, and readily accelerated. The pulse is frequent, small, and sometimes hard; and also, easily affected by exertion or emotion. At two periods of the day, noon and evening, there is an exacerbation of all the febrile symptoms, preceded by chill, and followed by perspiration. Perspiration is most profuse towards morning, and may then be regarded as a resolution of the evening's exacerbation. The urine varies; sometimes scanty and high coloured, more frequently copious and pale. The eyes, though sunk in hollow orbits, are usually bright and intelligent. The lower extremities become swollen by œdema. “The sleep is disturbed and unrefreshing; and there is a continual feeling of lassitude and debility; but with all this failing of the physical powers, the mind remains cheerful and unclouded to the last, and seems to gather fresh hope from the very causes of despair.”*

Such is the fever, strongly marked, and advancing to a fatal termination; but of course it is found to vary in duration, intensity, and issue, according to the nature and duration of the cause which called it forth. On removal of the cause, recovery is often extremely rapid.

Many imagine that the accession of hectic fever is attributable to the admixture of pus in the circulation. But it seems more reasonable to assign as its cause a very opposite circumstance, namely, the constant

* I cannot resist appending a beautiful description of some of the more striking features of this disease, from the non-professional pen of a most close and skilful observer of Nature —in all her varied phases and forms:—“But there were times—and often too—when the sunken eye was too bright, the hollow cheek too flushed, the breath too thick and heavy in its course, the frame too feeble and exhausted, to escape their regard and notice. There is a dread disease which so prepares its victim, as it were, for death; which so refines it of its grosser aspect, and throws around familiar looks unearthly indications of the coming change—a dread disease, in which the struggle between soul and body is so gradual, quiet, and solemn, and the result so sure, that day by day, and grain by grain, the mortal part wastes and withers away, so that the spirit grows light, and sanguine with its lightning load; and feeling immortality at hand, deems it but a new term of mortal life—a disease in which death and life are so strangely blended, that death takes the glow and hue of life, and life the gaunt and grisly form of death.”

draining away of that portion of the blood, its liquor sanguinis, which is peculiarly available for the purpose of nutrition. Pus we have seen to be a perversion of that portion of the blood; and the habitual loss of it seems much calculated to impoverish and weaken the frame, inducing febrile disturbance of healthy function, with debility as a prominent characteristic of such disorder. Pus, directly mixed with the circulation—if not speedily extruded by elimination—produces a much more grave disturbance of the system, as will afterwards be considered. During a profuse suppuration, it is not unlikely that a portion may be taken back again into the system, yet it is not a fluid easily absorbed, inasmuch as its solid particles are of large dimensions, and not fitted for passing through unbroken membranous coats; its serosity may pass readily, but the globules, when absorbed, must surely undergo some previous modification.* And so, if we are to suppose that the blood is contaminated by pus in hectic, there is every reason to believe that it is by absorption of it, and not by its direct intermixture; and also that the pus, when intra-vascular, is a modified form of that fluid. Yet such modified and indirect admixture of pus cannot be essential to the production of hectic, seeing that that form of disease occurs without any apparent purulent formation; for instance, as a consequence of hopeless organic disease in some internal part, of whose condition suppuration is not and has never been an element.

When pus is formed rapidly after the onset of inflammation, and diffused into the surrounding textures, from want of antecedent protective exudation of fibrin, the injury, as already stated, is great; by infiltration, disintegration, and gangrene. The constitutional symptoms attendant thereon, are not those of hectic, but of *Irritative Fever*; a condition, as it were, intermediate between the hectic and inflammatory, combining some of the characters of each. In the part, the advancing destruction of texture is preceded by spreading inflammation of a rapid and intense kind; the action tends to rouse the system, while its result on texture has the directly contrary effect. Such being the compound nature of the local mischief, it need not surprise us to find the general disorder, to which it gives rise, consisting of febrile excitement, modified and overborne by depression of the vital powers. The pulse is frequent and hard; at first with indication of strength but soon betokening manifest debility. The tongue is usually tremulous, and covered with a thick, dark-coloured, offensive fur; moisture gradually leaves it, and it ultimately becomes hard, brown, and dry. The urine is scanty, high-coloured, and of unpleasant odour; sometimes apparently suppressed. Sometimes there is diarrhœa, sometimes constipation. Rigors are frequent, followed by perspiration, usually profuse. There is much restlessness, with agitation of manner, anxiety of expression, and pinching

* This statement may seem at variance with the previously asserted formation of pus within the vessels, and elimination therefrom, as in ordinary secretion; yet the two circumstances are quite compatible, for there is good reason to suppose that the pus globules, when first formed, are comparatively minute, consisting of the molecules enveloped in a cell or cyst; and that, in the case of their intra-vascular formation, it is after their transudation that they enlarge to their ordinary dimensions, receiving their fluid contents by endosmosis.

of the features. Respiration is hurried and sighing, and there is a sensation of oppression at the chest. The mind is either greatly depressed, or excited by occasional delirium. The strength is much prostrated; hiccup sets in; and fatal collapse is imminent.

V.—Ulceration.

Until lately, the Hunterian theory was generally received, that ulceration, or the process whereby a breach of continuity is effected in a living solid, by the action of the part itself, was the exclusive work of the absorbents. Without denying that absorption, by both lymphatics and veins, goes on to some extent during ulceration, and that a part of the destructive process may be so produced—yet, there is every reason to believe that the major and more important part is effected independently of that class of vessels; and that ulceration is a product of true inflammation, consisting of, first, a vital softening of the changed and suppurated texture, which then undergoes molecular disintegration, and, reduced more or less to an apparently fluid form, passes away along with the purulent discharge. If by any means prevented from escaping, some of the fluid debris may be taken back by absorption into the system; ordinarily, however, it is washed away as both noxious and effete. And should it be otherwise, it must be remembered that such absorption of debris from the part, after it has assumed the fluid form, is a very different thing from the action which caused it to become so. The steps of the process are—1. True inflammation, with suppuration; 2. Softening of the truly inflamed part; 3. Its reduction towards a fluid form—a vital act—more or less complete; 4. Disintegration—or death and detachment—in minute portions, or molecules; 5. Mixture with the pus, and removal in one common discharge. Pervading this process, there is some absorption; but the amount of that action is not only inadequate to effect the change, but is even below the ordinary standard of health. It was diminished or almost arrested, during the persistence of true inflammation; although resumed, it is yet but feeble, during the continuance of true inflammation's product—ulceration. Sometimes there is good reason to believe that the originating inflammation does not subside at all on the occurrence of ulceration, but remains unimpaired, so rendering the latter action remarkably acute; then absorption will continue to be almost wholly in abeyance.

The more important arguments in support of such doctrine are the following:—1. Ulceration is an immediate result of Inflammation, or is co-existent with it; and during inflammation, absorption in the part inflamed is very much diminished, if not altogether arrested. Inflammation simply subsiding, on having just touched its true acmé, or barely so, is followed almost immediately by very actively renewed absorption, by which the inflammatory effusions are speedily cleared away; but when the action does not so subside, and advances to suppuration with ulceration, the result is otherwise; absorption is not renewed, with any energy if at all, until the action has abated. During the persistence of such action, inflammatory effusion may, to a certain extent, disappear; but only by disintegration along with the original tissues,

and admixture with the extruded purulent discharge. 2. Certain structures resist all stimulants to absorption, long and successfully, yet are remarkably prone to ulceration; and the inference seems plain that the two actions,—one opposed, the other embraced, by the same part, and at the same time,—must be dissimilar. Malignant tumours, for example, will not diminish in their true structure, far less disappear by absorption, yet are not only apt to ulcerate spontaneously, but certain to ulcerate when unwisely and rudely stimulated, as by friction or pressure. And certain normal tissues, as cartilage, may be long and much compressed, as by aneurism or abscess, without being affected by absorption; yet having become vascular, and the seat of perverted vascular action they ulcerate fast and readily. 3. In the case of virulent inoculations, whence the system is to be contaminated by absorption of virus from the part inoculated—as, for instance, in the primary venereal ulcer—it is usually considered that the system is safe during the *formation* of that ulcer. The part inflames and ulcerates; in a few days after the first blush of inflammation, the ulcer is fully established; and during these first few days, according to the Hunterian theory, there should have been great and constant activity of the absorbents, pouring in the virus into the circulation along with the debris of texture; but the experience of the practitioner tells an opposite tale—how there seems to be little or no absorption during that period, and that if he have an opportunity of destroying the part with caustic any time within that period, the disease is arrested, inasmuch as, up to that time, it has been entirely local, and not disseminated, by the play of the absorbents, throughout the system. Ulceration is a rapid process; and if effected by absorption, then the action of the absorbents in forming such an ulcer must have been great, and the system should have been inevitably involved long before the fourth or fifth day. And yet it is not so. 4. Ulceration is most rapid when absorption is generally supposed to be least active; that is, during the persistence of acute inflammation. 5. Passive venous congestion in a part is directly opposed to absorption, yet favours ulceration by proving a strongly predisposing cause to inflammation, which, occurring in a part of low vital power, passes on almost uncontrolled to a high result, namely, disintegration. All new formations are prone to ulceration in a similar way, being of low organism and weak vital power. Granulations, for instance, are so situated. They are liable to both absorption and ulceration; by the former—a slow, insensible process—the new formation is diminished gradually, contraction of the surrounding original textures is favoured and enhanced, and the extent of cicatrix diminished; by the latter—preceded and probably accompanied by inflammation—the cicatrix is undone rapidly, and the breach made wide and gaping as before. 6. A part to be absorbed is generally supposed to be previously reduced to a state more or less fluid. This change is not alleged to be the work of the absorbents, but is generally admitted to be the result of vascular action, infiltrating and breaking up tissue by fluid effusion. To constitute ulceration, it only requires the addition of molecular disintegration or detachment of the parts so changed—by further continuance of the destructive infiltration—which then inevitably mingle with the purulent

fluid to form one common discharge; and the idea of such addition seems infinitely more feasible, than to suppose absorption to be suddenly and actively resumed for the nonce, during the persistence of an action avowedly inimical to that function. After the disintegration and solution, a portion of the debris may be subsequently taken back by the absorbents; but these vessels are then dealing with the results of ulceration, not effecting that process. 7. Absorption is proved to be feeble during acute ulceration; a strong narcotic, in the fluid form, most favourable to absorption, may be then applied to the part with comparative impunity; while, subsequently to abatement of the ulcerative action, a much less dose will produce a much greater effect if brought in contact with the raw granulating surface.

Sundry objections to this theory will be noticed and explained, in treating of ulceration occurring in the different tissues.

Ulceration may occur either in an unbroken part, or where there has been previously a breach of structure. The process is begun by perverted vascular action, which sooner or later reaches its acmè, with suppuration; it does not stop there, but advances a step farther; to infiltration, softening, and partial breaking up of texture—true inflammation—is added farther softening and molecular disintegration—true ulceration. If on an open surface, the debris mingles with the purulent discharge, and so escapes; when on a surface previously unbroken, the discharge accumulates in the form of a pustule or small abscess; this breaks, its contents are evacuated, and the ulcerating surface is disclosed beneath. So long as true inflammation continues, ulceration does not cease; and the greater the amount of vascular action, and the less the amount of vital power, the more rapid and extensive is the work of destruction. With ordinary inflammation, and considerable power of control in the part, ulceration advances steadily, presenting the usual characters of the acute form of that process. With higher action, destruction is more rapid, very painful, and accompanied by greater redness, heat, and swelling; such an ulcer is usually said to be inflamed—all advancing ulcers are inflamed, but this form has inflammation as an unusually prominent characteristic. With still higher action, or with the same combined with less power, destruction is more rapid still, as if the part were consumed by some unseen agent; and the ulcer is termed *Phagedænic*. With action yet increased, and power impaired—one or other, or both—destruction is still more speedy, but in a different form; the part no longer dies in molecules, but in mass; ulceration is merged in gangrene. On the other hand, inflammation, having once established ulceration, may speedily thereafter subside; the latter action, under such circumstances, soon ceases, and is followed by reparation; such an ulcer is termed healthy or healing. Or, a subdued vascular action remaining, ulceration advances stealthily and slowly, and is said to be of the chronic form.

Again, the reparative action may flag and prove imperfect; the sore is then termed weak. Or there may be not only weakness and imperfection, but a total want of the reparative action; the sore is then called indolent. Or the work of reparation is from time to time interrupted by subacute inflammatory re-accessions, and the nervous function of the

part becomes pre-eminently disordered; such a sore is called irritable. Or the work of destruction has been combined with a tubercular vice in both the system and the part, and the work of reparation is thereby rendered feeble and impotent: such a sore is termed scrofulous.

The farther removed the ulcer is from the characters of the healthy and healing, the less *laudable* is the purulent discharge. Inflammation either persisting or advancing, the discharge is thin, acrid, not unfrequently bloody, and more or less impregnated with the softened debris. When, on the contrary, action has not only subsided from the inflammatory standard, but is becoming insufficient even for reparation, the discharge is either simply serous, or composed of this fluid containing a small amount of fibrin; which latter substance is neither in solution, nor in the form of pus globules, but in thin flakes.

By some, it is supposed that ulceration may be occasioned directly by Passive Venous Congestion—as in the lower limbs; and they consequently speak of the Congestive and Inflammatory, as different forms of ulceration. But it is not so. The congestion is the predisposing cause, not the immediate; it favours the occurrence of inflammation; and this coming, finds the part possessed of but little vital power—as, indeed, the existence of such congestion plainly indicates; suppuration and ulceration are soon reached; not the direct result of congestion, but of inflammation induced and aggravated thereby.

Certain tissues are more prone to ulceration than others. Skin, mucous membrane, and cellular tissue, are peculiarly liable to fall before it; while the vascular, nervous, and fibrous tissues resist it stoutly. Often advantage is derived from this; sometimes evil. The comparative immunity of the nervous and vascular tissues is plainly beneficial; and, in like manner, it is often fortunate that important parts are protected by fibrous expansion, which can successfully resist, at least for a time, the encroachment of suppuration advancing from without. But when the purulent collection is within the fibrous layer, then mischief is likely to accrue; inasmuch as the natural tendency of the pus outwards—by ulceration of intervening texture—is opposed, while deep and important parts suffer sadly by the delay.

The *causes* of ulceration are the same as those of inflammation. These actions are portions of the same general process, which commences with simple vascular excitement, and may end in gangrene. Ulceration is the higher grade—intermediate between suppuration and gangrene; something more than the former—disintegration and solution of texture, as well as the formation of pus; something less than the latter—the part not dying and being detached at once in a continuous mass, but slowly and by molecules. Whatever favours the occurrence and continuance of true inflammation, and whatever is unfavourable to the due maintenance of vital power in the part, whereby inflammation occurring might be resisted or controlled, is a cause of ulceration.

Inflammation subsiding, so does ulceration; and the action of destruction is followed by that of reparation—granulation. The succession may be rapid or slow. On the occurrence of gangrene, the dead part is separated from the living by ulceration; and in the furrow so

formed, the two actions of destruction and reparation are usually seen at work together and in harmony. The ulceration has not proceeded much deeper than the true skin, when already in the true skin granulations are being formed, as if with the view of at once closing the breach and atoning for the loss of substance. Whereas we find many a breach of surface in the lower limbs, in which ulceration has for weeks ceased, but in which there may be no effectual reparative effort for many weeks to come.

Ulceration may be attended by constitutional symptoms. If acute, inflammation persisting, there may be febrile disturbance of the inflammatory type. If chronic and tedious, with a profusion of discharge, hectic may ensue.

Of course, ulceration is to be considered as altogether different from loss of substance caused purely by absorption, either interstitial or continuous—independent of true inflammation, and unaccompanied by suppuration—a subject to be afterwards considered.

VI.—*Mortification.*

Mortification, an undoubted termination of inflammation as well as of all other vital change, may be reached at once, from intensity of action, deficiency of power, or a combination of both; or the intervening stages of suppuration and ulceration may be either barely touched at, or more or less dwelt upon. The broken up texture, softened, and infiltrated by liquor sanguinis, pus, and extravasated blood, has its circulation wholly arrested; and it dies, not by particles, slowly, and almost imperceptibly, but plainly, at once, and in mass. Vital power has ceased, chemical change advances unopposed, and the part is decomposed by putrescence.

Mortification is the general term which includes the whole process from its commencement to completion. It is subdivided into gangrene and sphacelus; the former denoting the process of dying; the latter, the result of this, or actual death of the part.

Gangrene being about to occur, the signs of the existing intense inflammation become modified. The redness passes into a dark and livid hue, for circulation has ceased. Circulation having been arrested, so is effusion, and the swelling grows less tense. All vital action decaying, pain and heat remarkably abate, and often cease suddenly. Sensation gradually leaves the part; just before, it could not be pressed on, however slightly, without much aggravation of pain, previously severe; now, even rude handling is borne with impunity. As the circulation, the source of animal heat, has ceased, temperature necessarily decreases, and usually with rapidity. The part containing much inflammatory effusion, chiefly fluid, putrescence is speedy, and increases both softening and moisture; and as the result of the chemical change, an offensive odour is more or less freely exhaled. The surface is usually studded with phlyctenæ; that is, elevations of the scarf-skin by putrid serum; readily distinguished from dark vesicles filled with bloody serum, which not unfrequently attend on simple bruise, by observing that the epidermis is not only detached from the cutis at the elevated

spot, but all around; that, consequently, the phlyctena may be made to slide from place to place, by slight pressure; and that the phlyctena is not attended with heat, pain, and swelling; as is the mere vesicle, but with all the other symptoms of advancing gangrene. When this is limited to the part originally inflamed, the discolouration is circumscribed, and may have its border even abrupt; but when the action, and injury which led to it, have both been severe—when the power of both part and system have been brought low—and when, in consequence, gangrene is to spread—the margin of discolouration is gradually lost in the surrounding paleness, and dark streaks are seen shooting diffusely upwards in the limb.

Sphacelus, or completion of the gangrene, is indicated by the part having become completely cold and insensible. It is shrunk in its dimensions, soft and flaccid, almost pulpy to the touch, and crepitates distinctly, containing not only liquid but gaseous contents,—the result of putrescence. All vital action has entirely ceased, and the chemical reigns paramount. The colour is black when the part is exposed to atmospheric influence; but when removed from this, as in sloughing of the cellular tissue, or of fascia, and in necrosis—the integuments remaining yet entire—the dead portions retain their normal hue but little changed.

When a part dies to a very limited extent—as a portion of skin, cellular tissue, artery, or tendon—the sphacelated part is termed a *slough*, and the process of death, sloughing.

Sphacelus being complete, and gangrene not extending, Nature instantly adopts means whereby she may free herself from a part which is of no farther use, and whose presence may prove seriously injurious. Its recovery is impossible; and if allowed to remain in close contact with the living textures, these cannot fail to absorb more or less of the noxious results of putrescence, both gaseous and fluid, whereby a poisonous effect will be produced on the system, already brought low by constitutional disorder attendant on the gangrene. The living part, in immediate contact with the dead, inflames; and, in consequence, the abrupt livid line is bordered by a diffuse, red, and painful swelling—the line of demarcation. This vesicates; the vesicle bursts, puriform matter is discharged, and an inflamed and ulcerating surface is disclosed—the line of separation. The furrow, so begun, gradually deepens; at first advancing with considerable rapidity, through the skin and cellular tissue, which are prone to ulcerate; but receiving a check, when fascia, tendon, or other fibrous texture is reached. The advance is seldom perpendicular, but in a sloping direction; and the inclination is usually towards, and, as it were, beneath, the dead part, gangrene generally being most extensive superficially. In time, even the most resisting of the soft textures are got through by ulceration, nothing but bone remaining undivided. No hemorrhage occurs during the gradual division of the parts; for the inflammatory process has passed leisurely through its ordinary grades; the exudation and partial organization of fibrin precede the suppuration, protecting the otherwise loose tissues from suppurative infiltration, and scaling up the otherwise open orifices of arteries and veins. But nature's amputation, so con-

ducted, is, unfortunately, a reverse of the ordinary operation; producing a stump, conical, and otherwise but ill-fashioned for useful purposes. The surgeon is, therefore, called upon to interfere in most cases, to modify the arrangement, and secure division of the bone or bones at a higher point.

We have been hitherto supposing that gangrene has involved the whole thickness of a limb, the line of separation forming on the cardiac aspect of the sphacelus, and sloping downwards. When the gangrene is less extensive, the process of separation is still the same—inflammation, suppuration, ulceration, on every aspect of the slough, until the dead portion is fairly separated from the living. On its separation, ulceration, still advancing, may be found beneath; but usually it is not so. The appearances are generally those of a healthy granulating sore. The inflammation is seldom greater than what is merely sufficient to secure disintegration and removal of that layer of living texture which is in contact with the dead, for the purpose of separating and throwing off the latter; and, at every point, where separation has been effected, inflammation and suppuration pass away, giving place to repair by granulation, which slowly effects a closure of the breach. Inflammation, by ulceration, is the agent which makes the furrow; repair by granulation follows closely on its heel. And so it is in regard to dead bone. The line of separation is scarcely visible between dead and living, when already preparations for the substitute bone have been begun. So quickly does restoration follow on destruction.

Constitutional Symptoms of Mortification.—During the period of inflammation, gangrene only impending, the constitutional symptoms are those of Inflammatory Fever; but so soon as gangrene has commenced, these symptoms pass more or less rapidly from the inflammatory type, to the typhoid form of Constitutional Irritation. The disorder has been so well described by Mr. Travers, in his late work on inflammation, as to render a transference of the passage entire more than excusable. "The pulse is increased in frequency, and diminished in diameter and force; in many cases irregular, and in some intermitting. A peculiar anxiety of expression appears in the physiognomy, and a remarkable livor overspreads the face, the features of which, the nose and lips especially, are contracted and pinched. The anxiety is soon exchanged for a hebetude of expression, as if the patient were under the influence of alcohol or opium; involuntary movements and tremors affect the hands and fingers, and frequent sighings are observed, which are broken by occasional hiccup. The inclination for food fails totally, the surface of the tongue is coated with a brown fur, harsh and dry, leaving the edge and tip free, but without moisture. As the case advances, the entire tongue, fauces, and lips, become dry to incrustation, so as to require constant moistening; but with small quantities of fluid, for swallowing is slow, and attended with difficulty. The skin, which in the onset was dry, opens to a copious but clammy perspiration over the whole surface. It parts sensibly with its temperature, and feels cold as well as damp. The mind, at first irritable—then, after the total subsidence of pain, stupid—wavers, and becomes subject to illusions, chiefly of a passive and transient kind; expressed by half sen-

tences, with a thick and broken articulation, and accompanied with startings and momentary gleams of insane excitement. In traumatic gangrene—the age and constitution being previously in full vigour—this low delirium is exchanged for fits of active and wild frenzy accompanied with loud cries and vehement efforts, requiring a powerful and continual restraint; and this continues, with occasional intervals from exhaustion, for hours together; and subsides, often suddenly, in prolonged coma and apoplectic death.” When but little of sthenic indication has preceded the gangrene, as in constitutions previously much weakened, or in the case of poisoned wounds inducing rapid death of the part, the delirium continues of the passive kind. The sphincters relax, and the excretions are passed involuntarily. The patient fumbles with and picks at the bed-clothes. More and more marked are “the death-like coldness, the clammy sweat, the small indistinct and flickering pulse, and the cadaverous expression. In this state a patient will sometimes lie totally insensible, and unable to articulate or swallow, for eighteen or twenty-four hours, and die without a groan or struggle.”

Such is the character of that general disorder which attends on gangrene. Death of a part is a direct shock to the frame, previously the seat of a febrile disturbance; and this depression is doubtless aggravated by subsequent absorption of noxious matter from the moist and crepitating mass of putrescence. The symptoms are found to vary, as is to be expected, according to the previous condition of the patient, the extent of the gangrene, and the importance of the part in which it has occurred. When the vital powers have been previously low; when the mortified part is vast; when an internal organ has perished, even in a patch or speck only,—the constitutional symptoms are invariably grave, and point to a fatal issue. The patient may sink within a few hours after the commencement of the typhoid symptoms; he may linger on for days; or he may rally and recover.

As certain tissues are found endowed with a faculty of resisting ulceration, so some are less prone than others to gangrene; those which are well supplied with vital power, and yet not liable to true inflammations—for example, the nervous and arterial tissues. In acute hospital gangrene, arteries are found playing in the dark and putrid mass; alive, whilst all is dead around them; but at length they also yield, and death is hurried on by the hemorrhage.

When mortification occurs in an internal part, many of the ordinary signs are of course deficient; and yet the symptoms are plain enough. We have not the blackness, nor the coldness, nor the crepitation; but we have sudden cessation of pain, previously most severe; failure of the pulse, and prostration of the strength; clammy sweat, collapsing features, and hiccup. These having occurred, we may confidently look for the other constitutional symptoms of gangrene, above enumerated. In short, it is important for the practitioner to bear in mind, in the management of acute internal inflammations—as, for instance, in the case of strangulated hernia—that the combination of hiccup and marked prostration, with sudden cessation of pain, plainly tells him of gangrene

having occurred in the part inflamed ; and that he is to frame his prognosis accordingly.

Such are the results of the inflammatory process ; some antecedent, some subsequent, to the true inflammatory crisis. Effusion of serum, fibrin, or both, attendant on the two preliminary grades of action, Simple Excitement, and Active Congestion ; the fibrin organized or not, and the effusion more or less permanent, according to the persistence of the action which occasioned it. Escape of blood, in the form either of hemorrhage or extravasation, by casual giving way of the vascular coats, during any period of the more advanced part of the process. Formation of pus, with extravasation of blood, softening and disruption of texture, and no organization of new deposit, attendant on the period of true inflammation. Beyond this, disintegration and solution are added to softening and disruption of texture, to constitute true Ulceration ; denoting that the inflammatory action is continued—not only not having subsided from its acmè, but persisting until a still higher result is attained. Or the circulation is wholly arrested, vital function ceases, and chemical change begins ; the part is dying, and dies—not in particles, but in one continuous mass ; Mortification.

VARIETIES OF THE INFLAMMATORY PROCESS.

Many and various have been the subdivisions connected with this part of the subject. But, for all practical purposes, it seems enough that we content ourselves with the simple division—at once the most ordinary and most useful—into *Acute* and *Chronic*. In the one case, the action advances with more or less rapidity through its various stages ; and having reached a climax more or less elevated—suppuration, ulceration, or gangrene—declines with a corresponding degree of alacrity. In the other the time occupied is not, as in the former, a period of days or hours, but of weeks or months. The action begins of a sluggish type, and retains that character throughout ; dwelling long on the minor stages ; seldom reaching to suppuration or ulceration ; and still more seldom to gangrene ; hovering rather on the other side of the true inflammatory crisis, and, consequently, dangerous to normal structure, by favouring fibrinous effusion and its subsequent organization. And when, having reached its climax—however low—it begins to subside, the decline is proportionably slow, and unsatisfactory because not only tedious but imperfect.

The two forms may be commingled. The action may be at first acute, but receiving a check, by treatment or otherwise, does not wholly recede, but merely dwindles down into a subdued form, and there remains, becoming chronic—chronic because moderated ; for it is found to be a tolerably true axiom in this vital warfare, that the hotter the action the sooner the restoration to peace ; or, in other words, the inflammatory process is not only brief when intense, and often protracted

when of a gentle kind, but brief because intense, and capable of lingering because of a gentle grade. A part under violent action is either soon restored or quickly perishes: under a mild form, it may bear up for a long period. Again, the action may be at first, and for long, chronic; but by the application of renewed stimulus, the acute form may be superadded, or, as it were, engrafted on the chronic—an occurrence invariably fraught with imminent danger to texture; for by the chronic form structure has been materially changed, as well as vital power much impaired, and the part so rendered an almost unresisting prey to the acute attack. Such a succession of the forms is very likely to be induced by injudicious or rash treatment, and ought to be carefully guarded against.

The Acute we may consider as representing the ordinary type of the inflammatory process, and consequently to have been already discussed. A few words will suffice to indicate the peculiarities of symptoms and results connected with the Chronic.

Symptoms of the Chronic form.—The action being both mild and gradual, the symptoms are comparatively little developed, and hence sometimes obscure. Redness, swelling, pain, heat, are slight; and of the last two sometimes there is almost nothing. Swelling, however, though at first slight, ultimately becomes a prominent and most important feature; it is considerable in extent—for it has been of long continuance, and steadily, though slowly, increasing; dense and firm in character—either consisting chiefly of fibrin from the first, or the serum having been absorbed; and tending to permanency of duration—having had time and action both favourable to organization; there is seldom any degree of tension, for, the deposit having taken place gradually, the parts have duly accommodated themselves to its reception. Suppuration, ulceration, and gangrene, when attained to, are, like the action which preceded them, slow and gradual in their advance to completion; attended by the ordinary symptoms of such results, in a mitigated form. Rapid and tense swelling, with softening of texture, we saw to be the characteristic of the acute form; gradual enlargement, with induration, is the characteristic of the chronic. In the latter, too, function of the part involved may be comparatively little disturbed; a liver or a lung, chronically inflaming, may continue their accustomed play, scarcely abated in either amount or efficiency—at least for a time. Sooner or later, however, function is disturbed, and that seriously.

The constitutional symptoms are proportionally mild. Febrile disturbance may be so slight as scarcely to be appreciated by either the patient or his attendant, especially if the action be seated in an internal part; when perceived, it is often both so obscurely marked and so transient, as to baffle or deceive in the effort of tracing it to its cause. The most prominent symptoms are want of refreshing sleep, loss of appetite, emaciation, change of colour in the general surface to a pale or dirty yellow, occasional flushes, sensation of cold, and frequent inclinations to shiver, impairment of strength, and a general feeling of uneasiness; the patient feels that he is ill, yet scarcely knows how or where. In the severe forms the febrile condition is more marked, and partakes, more or less, of the inflammatory type—headach, heat, fre-

quent and hard pulse, dry skin, scanty urine, thirst, restlessness; yet, the local action remaining chronic, the fever never attains to the form of the true inflammatory; it is less sthenic, less marked, less progressive, less continued. The tendency to remission, sometimes almost complete, is one of its most distinctive characters; the period of exacerbation is evening, or the early part of the night: morning, that of remission, with or without perspiration. Sometimes the local action itself assumes somewhat of the remittent character; seeming to have abated or even ceased during several days, while all the time it was steadily, though stealthily advancing.

It should never be forgotten that, however slight, and apparently trivial the constitutional symptoms of the chronic inflammatory process may be, yet, by their mere persistence they are likely to exhaust the frame, and induce a fatal termination.

On the occurrence of suppuration, they readily change into those of hectic. Gangrene having taken place, the typhoid form is as speedily assumed, low, and tending still downwards, from the beginning. An acute accession having been unfortunately superinduced, the true inflammatory fever may be assumed, at least for a time; but more frequently the effect towards sthenic action is but partially successful, and results in the irritative form of fever.

The *Results* of the Chronic Inflammatory process are thus seen to be chiefly formidable by the long continuance of the action, and the insidious nature of its progress; change of structure, all but irreparable, may have occurred before the attention of either patient or practitioner has been directed to the part. Gradual alteration of structure is the most ordinary result; by interstitial deposit, of a fibrinous kind, becoming more or less organized. Suppuration, ulceration, gangrene, though comparatively rare, yet may and do occur; they can scarcely be avoided, if the chronic form of action have for some time existed, and suddenly become merged in an acute inflammation.

THE MANAGEMENT OF THE INFLAMMATORY PROCESS.

Prevention.—Therapeutic means applied immediately after removal of the exciting cause, may have the effect of entirely frustrating its ordinary operation, and preventing perverted vascular action. For this purpose the period of incubation must be diligently improved. But to insure success, it is not only necessary, as can be readily understood, that the suitable means be early and sedulously employed, but also that the cause shall have been slight as well as transient; that its removal shall have been entire; and that the part have its vital power as yet unimpaired. The first effects of the stimulus we saw to be an impression on the nervous system, if not itself morbid, at least tending to a morbid result. The first object of preventive management is to mitigate or remove this. By some, hot water, or its steam, is applied constantly; and it succeeds in more or less subduing the nervous excitement—or breaking-off the first link in the chain. But the second step of the

initiatory process, seldom far disjoined from the first, we saw to be excitement of the vascular system of the part; and this system is likely to be further stimulated by the heated applications by which the other is soothed. Cold, continuously applied, is therefore, in my opinion, preferable; inasmuch as it is likely to fulfil a twofold indication, by exerting a sedative or depressing effect on both the nervous and vascular systems of the part, and so rendering the accession of the process still more improbable; absence of the first two links of the chain is very likely to frustrate the formation of the whole. But this simple remedy requires nicety and care in its application. The first effect of cold, as formerly stated, is sedative, the second reactive; the first opposed to vascular action, the second inviting its occurrence; the first we desiderate, the second we wish to avoid. To be prophylactic, therefore, its application must be continuous; if interrupted, however briefly, reaction is imminent—not only to arrest, but to undo the good effects of all the previous precaution. The most convenient mode of application is to cover the part by a loose layer of fine lint, and have a trustworthy attendant to keep this constantly moist and of low temperature, by cold water frequently and gently dropped on it out of a sponge; the slightest dryness or warmth being dreaded as a source of disaster and disappointment. Or the assistant may be dispensed with, and a process of constant irrigation employed; a thin strip of lint communicating, syphon-like, with the lint on the part and a water-vessel placed in its immediate vicinity. The bed-clothes, if need be, are protected by the interposition of oil-cloth, arranged slopingly, so as to favour the draining away of the water, after it has trickled, in a constant though tiny stream, on the seat of injury. Besides, the part is to be kept rigidly quiet, or at least as much so as circumstances will possibly permit; and it should be also so placed as to favour venous return and oppose arterial influx, at the same time relaxing those muscles which are either directly or indirectly implicated. Both mind and body should be placed and kept at rest; and low diet, with abstraction of all stimuli, whether local or general, must be rigidly enjoined. Parts simply stimulated—that is to say, without wound—may by such treatment be altogether saved from inflammatory accession; and many incised wounds may thus be brought to rapid and almost painless healing, by adhesion—the inflammatory process not having been wholly prevented, but so subdued and limited as never to reach even the vicinity of the true inflammatory acmé. It is only sometimes that we are able to prevent every part of the inflammatory process; but in many cases we may thus prevent that advancement which constitutes true inflammation.

Treatment.—*Removal of the cause* ought assuredly to be the first care of every practitioner who is called on to subdue the inflammatory process. That preliminary point having been successfully carried, he will then be enabled to attain his principal object by the use of comparatively slight means; with little trouble to himself, and at the expense of comparatively little pain, annoyance, delay, or danger to the patient. Whereas, let the all-important preliminary step be either neglected or imperfectly secured, and all the most powerful remedial means may be

unceasingly employed, with little or no avail. Nothing is more common than a patient to apply for relief, on account of nascent inflammation of the conjunctiva, caused by the lodgement of foreign matter in that membrane. Remove the particle of dust or sand at once; and then, fomentation, a shade, a purge, careful diet, and perhaps a few leeches, will, in the great majority of cases, suffice to dissipate even the most formidable of such ophthalmiæ, within a few days at the utmost. But, on the other hand, leave the foreign matter imbedded in the inflaming part; and then, leeches innumerable, bleeding from the arm or from the temporal artery, once and again, blisters in almost endless succession, purges, antimonials, mercury pushed to profuse ptyalism, and perhaps repeated—in short, ruin to the system by severity of treatment may be enforced and endured, without arresting the action, or preventing loss of vision by irreparable change of structure. And this is not mere fancy. Cases are on record of eyes having become pearly white and sightless, notwithstanding the induction of anæmia, dropsy, and mercurial disease—premature age and infirmity—by the attempts to save; all the while, some small particle of foreign matter lodging undisturbed, and probably unsuspected, in the lining of the upper eyelid—whose simple removal might have saved both eye and system to the patient, as well as credit and conscience for the practitioner.

Our first duty is to inquire carefully for the exciting cause. If already removed, good and well; if still in operation, we are to procure its abstraction as speedily and effectually as may be in our power. And then we are in a favourable position to proceed with the directly remedial means—those which are opposed to the advance and persistence of the inflammatory process, and consequently termed *Antiphlogistics*. The most important of these is *blood-letting*; and the blood may be taken either from the part, or from the system at large.

1. *General Blood-letting*.—In the outset it is to be observed that this is not invariably necessary. It is a spoliative remedy of the highest class, and therefore never to be had recourse to, unless circumstances declare it either imperatively demanded, or at the least highly expedient. There is every reason to fear that this little operation—afterwards to be described—is too frequently employed; frequently, because heedlessly—when it might have been well superseded by other and more gentle measures, or when actually no benefit, but sad injury, flowed from and with the “purple stream.” It is a very easy matter to take away blood, and thereby induce debility; while to undo that result, is in most cases difficult, and often impossible. Congestions, serous effusions, bloodless cheeks, atrophied and all but palsied muscles, a withered frame and an enfeebled mind, may remain, silent yet steadfast and truth-declaring witnesses of the error in practice. On the other hand, the practitioner will be equally culpable by refraining from this operation, when the circumstances of the case call plainly and loudly for its performance. And it may be stated broadly, that general blood-letting is required; when the inflammatory symptoms—local, general, or both—are severe—as in many examples of phlegmonous erysipelas and compound fractures; when the part affected is of importance in the animal economy—as the lung, bladder, or kid-

ney; or when a delicacy of texture is involved, whose maintenance is essential to function—as in the eye, in the synovial membrane, and in the nervous tissue in general.

The bleeding is not to be regulated by its absolute amount, but by its effects. No idea should be entertained that in one form of disease a certain number of ounces will suffice, while in another a greater, and in a third a less amount must be invariably taken. In every case, the thought of measure is to be abandoned, and the blood permitted to flow on until the desired effect has been obtained; then the stream is arrested, irrespective of whether the ounces amount to three or thirty. And in connexion with this point, it is farther to be remembered, that true inflammation engenders a *tolerance* of this remedy. A young, robust, healthy man, may be bled when he does not require it; but most probably twelve or fifteen ounces shall not have flowed, ere nature interposes her objection to the procedure, and syncope is produced. Whereas, open a vein in the arm of even a weak, pale-faced, nervous patient, who is the subject of an acute inflammatory seizure in some important part, and it is not improbable that double that amount, or more, shall have been withdrawn ere any considerable effect has been made upon the patient's system. So truly and generally does this obtain, that an important auxiliary in diagnosis may be thence derived. You are bleeding a patient, in doubt whether the disease is truly inflammatory or not, but you suspect that it is, otherwise it is likely you would not have performed venesection; only a few ounces have escaped, when the patient grows pale and faint; you arrest the flow, and reconsider your diagnosis, suspicious of an error. But should no faintness threaten after a full or even large abstraction, doubt is removed, your diagnosis is confirmed; you advance unhesitatingly with the antiphlogistics; the disease is there, and has engendered a tolerance of the remedy. On coming to a conclusion from this source, however, care must be taken to ascertain that the syncope, or tendency thereto, is an actual failing of nature, the effect of the loss of blood, not the result merely of fear or other depressing agency on the patient's mind. When aware that the patient is naturally timid, and liable to faint from this cause, and when at the same time confident that he labours under true inflammation, and that the circumstances demand effective blood-letting—we will bleed him in the recumbent posture, and with a gentle stream.

Tolerance of bleeding will also be found to vary according to the sex, age, and temperament of the patient, *cæteris paribus*; greater in the male than in the female; greater in adult age, than at either of the extremes of life—in early infancy it is most especially small—in advanced years it is not likely to prove so obviously and directly calamitous, yet is a spoliation hard to be borne; least in the nervous, greatest in the sanguine temperament.*

* Tolerance of bleeding in inflammation is attributed by Dr. Williams to "increased excitability of the heart and tonicity of the arteries, which maintain a sufficient force and tension to preserve the circulation, especially through the brain, even when much blood is lost. In asthenic or atonic diseases, on the other hand, the arteries being lax, and ill-fitted to transmit the blood, a smaller loss is felt, and syncope may result."

Similar tolerance of appropriate remedies seems often to be generated by disease. In fact it may be laid down as almost a general rule, that a remedy—in itself severe—appropriate to a given form of disease, may be administered in even large quantity during the persistence of that disease, with not only relief to the symptoms, but with comparative impunity to the system at large; whereas the same remedy, given even with a sparing hand, while no such call for its employment exists, is certain to affect the constitution injuriously. In nervous disorders, as one form of delirium tremens, opium can be given in doses, a tithe of which would fatally poison the person if in health. In inflammation of the lungs, tartrate of antimony is given to an extent which would, under other circumstances, be absolutely intolerable. In iritis, synovitis, and certain forms of the venereal disease, in which the use of mercury is not only expedient but essential, that mineral can be pushed with safety; it is to the sakeless salivations—errors either of judgment or of diagnosis—that the ruin of mercurially-shattered frames is attributable.

The effects of general blood-letting, in so far as they are remedial of inflammation, are, 1. A sedative result on the heart's action, on that of the arterial trunks, and thus on the general circulating system; effected partly by withdrawal of its wonted stimulus, the blood, from the central organ; and partly by the depressing effect of sudden loss of blood on the nervous system, which reacts in a corresponding strain upon the circulating. And this sedative effect on both heart and arteries is proportionally indicated, by diminution of the hardness and thrilling of the pulse, as well as of its fulness and frequency. It is plain how such lull of the general circulation is advantageous, as regards both the local action and the fever which accompanies it. 2. The blood is diminished in absolute volume. In some cases this is not desirable; on the contrary, we may be not more anxious to crush rising inflammation, than to husband the vital resources already weakened, and especially to retain this all-important fluid unwasted and undiminished; we therefore bleed sparingly, if at all. Yet there are cases in which the blood is preternaturally increased in quantity, as well as changed in character—as in inflammation occurring during well-marked plethora; in such circumstances diminution of volume will favour resumed general control of circulation, at the same time lessening the probability of sanguineous determination to any individual part. 3. The blood is also affected somewhat as to its component parts. These do not pass out from the open vein in their ordinary and equable proportions, but some more than others; at first the red corpuscles escape most freely, and then the proportion of fibrin also is found to have sensibly diminished. Physiology scarcely enables us yet to reason accurately on the effects of such change; but it is not unreasonable to suppose, that by thus parting with the oxygen-carriers, and with the matter of true plasma, heat and perverted nutrition—two sufficiently prominent symptoms of the diseased action—may be mitigated. 4. Derivation of blood is effected from other parts—the inflamed probably benefiting in an especial degree—to that whence the blood issues. However this is effected—whether according to mechanical or vital laws, or both—

microscopical observation, corroborating what had been previously inferred from experience, has established the fact, that it does occur. Have an inflamed part beneath the field of the microscope, and draw blood by a puncture from another, even distant point; blood will be seen actually leaving the part inflamed to meet the increased demand elsewhere; and even stagnant portions will be seen to disentangle themselves, and resume a brisk movement for the same purpose. This derivative effect is plainly in favour of the burdened part. It may be that it is but temporary, ceasing almost with the flow that caused it. Yet granting such to be the case, still an important advantage has been obtained; inasmuch as even this temporary relief may be such as to enable the capillaries in some degree to recover their tone, and the parenchyma to accommodate itself better to the temporarily diminished effusion. 5. The action of other remedies is facilitated. "By lessening that morbid impetus of the blood (and increased tone of the vascular coats) by which during the state of inflammatory fever the natural excretions are apparently impeded, and at the same time by promoting absorption into the blood (as loss of blood is well known to do) it favours the effect of all other evacuating remedies intended to act on the excretions of individual parts of the system."* And farther, by its precedence, it renders certain remedies—as mercury and opium—decidedly beneficial, which otherwise would have proved either inoperative, or absolutely injurious.

These beneficial results of blood-letting are materially affected by the manner in which the blood is withdrawn. As already stated, it is desirable, in the great majority of cases, to obtain the effects, more especially the sedative, at a cost of as little blood as possible; and with this view, the manner of abstraction becomes all-important. Make a large orifice in a vein or veins, let the blood escape in a rapid, full stream, with the patient in the erect or semi-erect posture, and syncope is soon arrived at; these circumstances tending to sudden withdrawal of wonted stimulus from the heart, and diminution of arterial supply to the brain. Whereas, blood may be taken in large quantity—especially when tolerance by disease exists—from a small aperture, in a slow and small stream, during recumbency; in fact, the system may be thus almost wholly drained of blood, ere faintness threaten to ensue. And thus we see how slow venous hemorrhages, of accidental origin, prove so dangerous; faintness, so favourable to the spontaneous and effectual arrest of the flow, by formation of coagulum, is too long deferred. Syncope may be, in truth, regarded as nature's safeguard from hemorrhage. In the case of accidental wounds, it usually supervenes ere actual danger has accrued from the loss, allowing the vascular orifices to contract and become occluded by coagula. When blood is designedly taken in the treatment of disease, and when it is proper that blood should be so taken, there is tolerance; or in other words, syncope remains in abeyance till a sufficiency shall have flowed. But should an error of judgment have been committed by the practitioner, nature is ever watchful to retrieve it; and where blood is flowing

* Alison.

when it ought not, very little is lost ere syncope ensues, and arrests the stream.

In antiphlogistic bleeding, then—except in the comparatively few cases in which actual loss of blood is desirable—the abstraction is made rapidly, in the erect or semi-erect posture. But syncope is to be approached rather than actually attained. Our object is, not only to produce, but to maintain a sedative effect on the heart and general circulation; if syncope occur, reaction is almost certain to prove excessive; whereas, if the immediate result be less extreme, it is more easily retained; by stopping short of actual syncope, excessive reaction is rendered both less probable and more readily controlled. Besides, a fainting-fit may prove in itself somewhat dangerous; if there be either organic disease in the heart, or a considerable effusion in the pericardium, the cessation of the heart's action may prove permanent. So soon, therefore, as the symptoms of approaching syncope show themselves, we usually desist from blood-letting; when the patient grows pale, and articulates faintly and with difficulty; when he begins to fail from the semi-erect posture, sighs, and shows signs of nausea; when the lips grow dry, white, and quivering, the eyes dull and glassy, and a cold sweat bedews the face and forehead; when the pulse becomes weak and fluttering—then we bind up the arm, and place him gently recumbent. From twenty to thirty ounces may be estimated a fair average first-bleeding, in a case of inflammation attacking a robust adult; but, as already stated, it is better to keep mechanical admeasurement altogether out of the question.

From the depression by bleeding the circulating system rouses itself, more or less rapidly, and the result is termed *reaction*. This either remains of a tolerably quiet and subdued character, the inflammation having simply given way; or it becomes excessive. And excessive reaction may be of two kinds. 1. It may be of an asthenic or nervous character, indicated by rapid, soft, and jerking pulse, oppressed breathing, headach, and tinnitus aurium, general nervous excitement, and non-return of the ordinary inflammatory symptoms—a state of system very similar to what follows on simple loss of blood in large quantity. To bleed again would be to aggravate such disorder. A full opiate is administered; the nervous excitement is allayed, the patient falls asleep, and awakes with a calm pulse and system, relieved as if by the working of a charm. The opium here does not create the sedative impression on the circulation; given by itself, it most probably would not only have failed to quiet, but have increased the tumult; but coming after bleeding, it restores the sedative result which this had achieved, but was unable singly to maintain. 2. But reaction may be of an opposite kind—sthenic; in fact, a continuance or re-accession of the inflammation. The pulse is hard and vibratory as before; the fever still retains the inflammatory character; local heat and pain are still unsubdued. The inflammatory process has been interrupted, but not arrested; the remission proves but transient, and the re-accession may be more fierce than the original onset. This must be met by the lancet. A sound bleeding is to be practised, so soon as such reaction has declared itself. A few ounces drawn then will suffice to restore

the sedative effect of the former bleeding; while double the original amount may fail to make a satisfactory impression, after time has been allowed for the re-accession to make head and be established.

The paramount importance of *time*, in connexion with blood-letting as an antiphlogistic, should never be forgotten; whether it be practised to crush the rally, or meet the original attack. Comparatively speaking, one full bleeding of ounces, drawn early—just at the onset—will be far more available as a remedial agent than quarts taken at a subsequent period; and then not only will the cure be less complete and satisfactory—change of structure having occurred by effusion, and resolution proving both gradual and incomplete—but to obtain this secondary result, the system must be sadly shaken by the severity of the treatment employed. “*Obsta principiis*” is the invariable motto of the antiphlogistic phlebotomist.

The signs of bleeding having proved effectual are, in general, sufficiently plain. The pulse loses its hardness and thrilling, becoming soft and compressible; it may be more or less frequent than before, often the former, at least in the first instance. The pain and heat either cease in the part, or continue in a mitigated form; the other ordinary signs recede; function returns, both in the part and in the system; secretion, general and local, is restored; and usually the blood, when drawn, ceases to exhibit the inflammatory character. It must be borne in mind, however, that this result is not invariable. Exceptions to the general rule in this respect are by no means unfrequent; and blood may be at least buffed, if not cupped likewise, notwithstanding that the inflammation has given way; while, on the other hand, action may be persisting, while the blood seems scarcely sizzly. It therefore follows that, in either case, when the evidence of the blood is opposed to that of the other inflammatory signs, the latter are to be believed and to guide the practice; but usually they will be found to agree in one indication.

Certain circumstances materially affect the practice of blood-letting, and ought always to be taken into consideration. 1. The duration of the action. At its commencement, general bleeding may be expected to produce the happiest results; at a more advanced period, a greater quantity of blood must flow, but still the effect may be in the end satisfactory; but after some considerable time has elapsed, the system may be drained of blood to an absolutely ruinous extent, and yet little impression may be made thereby upon the local disease. 2. The age, sex, temperament, and occupation of the patient. The first three have been already noticed as affecting the tolerance of the remedy. Occupation is equally important. The robust and temperate peasant will require a larger bleeding, and bear it better, than the pale and too often dissipated inhabitant of the crowded city. And, again, among the latter class important variety is found; some—brewers’ servants for example—being found especially intolerant of this remedy. 3. The nature of the part affected. Many an inflammation of an external part requires no general blood-letting; while the inflammatory process can scarcely alight on any internal and important organ, without not only demanding this remedy, but apparently imparting to the system power to bear the necessary spoliation. 4. The state of the system previous

to the inflammatory attack. The patient may be plethoric; we may then bleed almost recklessly, and in the recumbent posture; better content with a large than a small amount of ounces. He may have been anæmic; we either forego venesection altogether, or practice it most cautiously, using every means in our power to secure the desired effect with the least possible expenditure of the valuable fluid. 5. The ulterior result. After severe mechanical injury, it is very desirable to limit the secondary occurrence of gangrene, and the obvious means of doing so is by active antiphlogistic measures to mitigate the action which is setting in; but in effecting this object, blood must be taken sparingly and with much caution, seeing that a certain amount of gangrene is inevitable, attended with its usual constitutional symptoms of depression; and on separation of the sloughs, a profuse and hectic-causing suppuration is equally certain to ensue. It may be very easy, by heroic expenditure of blood, to attain the object immediately in view; but, in all probability, it will be very difficult to prevent the rash levelling blow, which arrests inordinate action, from at the same time annihilating the patient's chance of ultimate recovery.

Blood may be drawn from the general system either from an artery or from a vein—*arteriotomy*, and *venesection* or *phlebotomy*. When the former is practised, a superficial branch—usually the anterior—of the temporal artery is generally selected. Blood can be thus taken both in large quantity and with much rapidity, so as to secure the desired sedative effect; but it is an operation which demands more dexterity in performance than venesection, and is, besides, not unlikely to be followed by troublesome consequences, as will afterwards be explained. A subcutaneous vein, on the contrary, is superficial and easily reached. Blood can be drawn both rapidly and in quantity, if need be, by means of a large orifice; arrest of the flow is more easily effected than in wound of an artery, and the incision is more likely to unite simply by adhesion. Hence, venesection is usually preferred; and the points of selection are, one of the veins at the bend of the arm, for general purposes; and the external jugular vein in the lower part of the neck, in certain cases; operations which will be duly treated of in the department of special surgery. In many patients, especially females affected with obesity, it is not always an easy matter to reach a vein at the ordinary sites; but when foiled there, it does not inevitably follow that arteriotomy is the only other resource. For, if venesection be rendered preferable by circumstances, it is to be remembered that a sufficient vein—the cephalic—is always to be found by a slight and sure incision, placed in the interspace between the deltoid, and the clavicular portion of the pectoralis major muscles.

Hæmostasis, or temporary arrest of a portion of the blood, apart from the general circulation, has been proposed, as an occasional, or, perhaps, even frequent substitute for blood-letting; or, at all events, as an useful auxiliary.* The blood of a limb, or of limbs, may be readily retained therein for some time, by deligation sufficient to arrest the venous return; and this may possibly have the effect of relieving the

* *Maryland Medical and Surgical Journal*, March, 1843.

general circulation; the sluices being afterwards slowly opened, so as to permit the gradual escape of the pent-up fluid. Such procedure is sufficiently ingenious, and not unpromising in theory; but it requires attestation by experience ere it can be recommended in practice.

2. *Local Bleeding*.—This is usually associated with general blood-letting—securing relief of the part as well as of the system. It operates beneficially on both—on the part, by removing, or, at all events, diminishing its sanguineous burden; on the system, by keeping up the sedative effect on the general circulation, which the general bleeding had previously produced. And, further, it is to be borne in mind how constitutionally important is the early use of such a remedial agent directly affecting the part, inasmuch as that part being the laboratory whence issues the inflammatory change of the blood, the sooner the inflammatory process is arrested therein the less will be the probable amount of febrile disturbance in the system.

But, under certain circumstances, the local is preferable to general blood-letting, and supersedes it altogether. 1. When the inflammatory action is trivial in itself, and situated in a comparatively unimportant part, there is no reason, but the contrary, why the system should suffer, when local remedies are perfectly adequate to the subjugation of the local disease. We do not “raise a storm to drown a fly.” 2. When the powers of the system have been low previous to the inflammatory accession. General bleeding being obviously from this cause inexpedient, and the local change having not advanced so far as to create a fictitious tolerance of it, we content ourselves with a local depletion; but sometimes we may carry that so far as to approach in its effects the severer form of the remedy. 3. When the inflammatory process has been fully established, and is far advanced by continuance. It has been already observed, that in such circumstances even a great loss of blood from the arm will probably fail to produce a remedial effect on the part; to practise it would be to weaken the frame unnecessarily. Local bleeding, even though frequently repeated, will occasion much less general exhaustion, while it is dealing successfully with the disease. 4. Either extreme of age forbids general bleeding, unless in extreme circumstances; indeed, in both the very young and very old, local bleeding, when at all considerable, is in its effects tantamount, or nearly so, to the general; the latter will, in the majority of cases, prove not only unnecessary to the treatment, but absolutely intolerable to the system.

A general rule applicable to local bleeding has been much insisted on by M. Lisfranc, and not without good show of reason; namely, that blood, when drawn with an antiphlogistic object, should not be taken immediately from the affected part, unless in large quantity. A few leeches, placed in the near vicinity of an inflaming part, relieve, by drawing blood from it. They are antiphlogistic by derivation. The same number, placed on the part, draw blood from the parts around to the source of the flow, and thereby tend to increase sanguineous determination, instead of relieving it. If direct application is to be employed, the quantity taken must be large, truly spoliative; as it were emptying the part, notwithstanding its borrowed supply from the vicinity.

Local bleeding, therefore, to be antiphlogistic, must either be small in amount, and indirect in its extraction, or direct and copious. Let it be the latter, when a constitutional effect as well as local is both expedient and permissible; the former, invariably, when we are anxious to husband the general vital powers, and to attack only the local malady. The foregoing observations, of course, do not apply to abstraction of blood directly from the part by puncture, scarification, or incision; these, however slight or few, cannot fail to rife the part of its fluid contents, and, besides, they have other fully as important indications to fulfil.

Blood is withdrawn locally in various ways—by cupping, leeching, puncture, scarification, incision.

Cupping.—This, when the means are at hand, and the nature of the part is suitable to their application, is, perhaps, the preferable mode—less tedious and annoying than leeching, and likely to prove also more effectual. Rapidity of abstraction we saw to be useful, in obtaining a sedative effect on the system. Probably it is similarly useful when directed upon the part. Much blood may require to flow by the slow oozing of leech-bites, ere the spoliative and sedative result is obtained. Half the quantity, suddenly removed by cupping, may prove equally or even more successful.

This little operation is performed in the following manner:—The surface is first hotly sponged, and then the cups—duly exhausted by the spirit-lamp—are fixed on the parts whence the blood is to be taken; this creates a determination to that portion of the surface; at once facilitating the abstraction of blood, and causing a derivation itself favourable to the inflaming texture. By heat and moisture this determination to the surface is maintained throughout the operation. The cups having been removed, the scarificator is instantly applied to the red and swollen parts; and the incisions are made deftly, with the instrument pressed lightly on, and with the range of the lancettes so modified that they shall penetrate not more deeply than the true skin, otherwise the adipose tissue will fill the wounds, and arrest the flow of blood. The scarificator, so soon as it has been discharged, is replaced by a hot sponge, and this again by the glass fully exhausted, yet not too much so, otherwise the pressure may be so great as to obstruct the circulation of the part. The changes are made as rapidly as possible. The blood, as it escapes more or less freely, rises to fill the vacuum; so soon as it begins to coagulate, or sooner if the flow be tardy, the glass is removed, emptied, and reapplied, freshly exhausted. On each reapplication, it is well to shift the glass slightly from the former site, so that the pressure of its rim—often severe—may not be injuriously concentrated on one and the same circle of integument. During the interval of reapplication a warm sponge covers the wounds; and on leaving is made to rub them somewhat rudely, in order to prevent the lodgement of coagula. Detachment of the glass is effected carefully, by pressure of the finger applied to the uppermost part of the rim; the glass, thus loosened by entrance of the atmospheric air, is slowly bent, as it were, downwards, a sponge pressing firmly on its rising edge, so as to sweep all the blood into its interior, leaving the bed and body

clothes unsoiled. The number of glasses, and of their reapplication, are varied according to the amount and rapidity of abstraction desired; the average product of a single glass may be held as ranging from four to six ounces. If the glass be placed over a wound or wounds, fed by a distinct arterial branch—such as the anterior of the temporal artery—the portion of the rim which overlays this vessel, on its cardiac aspect, is to be a little raised, so as to permit free arterial influx, otherwise the bleeding will prove but scanty. Abstraction over, the parts are lightly and cleanly sponged, and covered by some simple adhesive plaster; usually they heal readily by adhesion. But it may be desirable that they should not do so; the case may be such as to render advisable the early succession of counter-irritation to local bleeding; the wounds are then treated by stimulants, so as to favour inflammation and suppuration, and the scarified part is thus speedily and easily converted into a suppurating issue.

Much ingenuity has been expended in adapting apparatus to the performance of this operation; but I believe that all modifications have, each in their turn, been found inferior to the ordinary mode by simple glasses, exhausted by the spirit-lamp. Much practice, however, is necessary, ere the dexterity of a neat and successful manipulator can be acquired.

Leeches can be used when and where cupping-glasses and scarificators can not. Their application is simply effected by confining them in a glass or wire-gauze receptacle, which is inverted, and held steadily till they fasten on the part whence we wish the blood to issue; they are thus effectually prevented from sprawling abroad diffusedly, as their caprice would probably lead them. The part is previously made smooth by abrasion, and clean by ablution, especially if fœtid or otherwise noxious matter have been formerly applied. Appetite is increased in the animals by their being dry, both outside and in; on this account they should be kept for some time out of water, and gently dried with a soft towel, before application. If still slow to bite, they may be briefly immersed in warmish porter; and the part may be smeared either with a little sweet cream, or with blood freshly drawn from a puncture. When the animals have filled and loosened, the part is diligently and hotly fomented, so as to encourage oozing from the apertures; and by this the greater part of the bleeding will probably be taken. Each leech, or rather each leech-bite, may be rated at about an ounce and a half. Sometimes the hæmorrhage is troublesome by continuance from one or more of the apertures. Let firm, direct, dry pressure be maintained for a short time, and this will probably be sufficient for its arrest. If not, insert the point of a finely pencilled portion of nitrate of silver carefully into (not on) the aperture; press steadily with it there for a few seconds; and immediately on its removal apply a dry compress, retained by either the finger or a bandage. It is not often that this procedure is demanded; and still more rarely does it fail, when duly practised. If it should, transfix the part by a fine needle, and encompass this firmly by a ligature, as in the formation of the “twisted suture.” Troublesome bleeding is most likely to occur in children, more especially if the leeches have been applied to parts,

not only of active circulation, but also exposed to constant or frequent motion, as in the neck. And it is a safe general rule, applicable to leeching at a tender age—when, as we have seen, much bleeding is but ill borne—that the patient be not left, particularly over night, until the bleeding has fairly ceased. To leech a child on the chest or neck, cover the part with a large hot poultice, and leave it thus for some hours, is to encounter a great hazard of the patient's perishing by hemorrhage. In regard to children, it should further be remembered, that the loss of blood by a few leeches is equivalent to a full bleeding from the arm in an adult; that in them, in short, a local is equal to a general blood-letting. "Three leeches, bleeding well, are a full bleeding for a child of one year, at least of the average strength of those brought up in great towns; and if one is added for each year of the child's age up to five, a fair number for a single evacuation may be obtained. Beyond this age, in strictly inflammatory cases, bleeding at the arm is certainly to be preferred."* *San Myck*

But there are other precautions to be regarded, in the application of leeches:—1. They should not be placed where there is either frequent or constant motion, as on the neck, or over the costal cartilages; otherwise the bleeding is not unlikely to prove troublesome. 2. Nor should they be placed on parts habitually exposed, especially in females; otherwise the cicatrices may prove unseemly. And when it is remembered that local bleeding, unless in large quantity, is usually more effectual, when indirectly than directly taken from the part, we shall seldom find it difficult to fulfil the foregoing indications. 3. In children it is well to avoid large superficial veins, especially in the neck. 4. Nor should they be placed where the fibro-cellular tissue is peculiarly lax and delicate, as in the eyelids; otherwise ecchymosis, acute œdema, or both, are apt to ensue. 5. Nor where subcutaneous nerves abound, otherwise much pain will be occasioned, and the occurrence of either erysipelas or angeioleucitis rendered not unlikely; in the case of the fore-arm, for example, the dorsal will be preferred to the palmar aspect. 6. They should not be placed directly on the part inflamed; for (1.) unless in sufficient numbers to prove spoliative, their effect will not be antiphlogistic, but the contrary; and (2.) because they are apt to prove irritant, and, by adding fresh stimulus, to hurry on instead of arresting the inflammatory process. For example, punctures are more suitable than leeches to an erysipelas. 7. They should not be placed in the immediate vicinity of an acute ulcer, more especially if this be of a specific kind; otherwise the bites are apt to be inoculated, and consequently to degenerate into ulcers, so extending instead of limiting the evil. 8. Nor should they be applied, unless considered truly indispensable, where bandaging or other retentive means are of paramount importance, as in fractures of the limbs; for, under such circumstances, the wounds are apt to inflame and ulcerate, compelling a discontinuance of the most important part of the apparatus, and probably at a critical time of the cure.

Blood may also be taken from a part by *punctures*, as in simple

* Alison.

erysipelas; by *scarification*, as in inflammatory affections of mucous membrane—the eyelids, for example; by *incision*, as in urgent phlegmonous erysipelas. But in addition to abstraction of blood, these wounds perform the more important indication of withdrawing the inflammatory effusions—serous, fibrinous, and purulent—and thereby affording most important relief to the part; not only removing what has been already exuded, but affording a ready exit to the coming effusion, instead of its being infiltrated into the surrounding texture.

3. *Purgatives* are generally an important item of the antiphlogistic catalogue, and are used early. They disburden, by clearing away accumulated matter from the intestinal canal, and so overcoming one of the most prominent symptoms of the inflammatory disease—constipation; and likewise, by such clearance, favouring the action of other medicines. Before bleeding, large doses will be necessary, perhaps ineffectual; after loss of blood, a much weaker purge will obtain the end desired. They deplete, by causing an increase of mucous exhalation from the lining membrane of the bowels; and so assist the direct abstraction of blood from the system. They may sometimes exert a derivant effect in favour of the part inflamed, by bringing an unusual amount of blood to the intestinal canal. They are further of use by opposing assimilation, and thereby cutting off the nutritious supply from the circulation; thus tending to maintain the wished-for depression of the system. During the decline of action, they are still of use—if not contra-indicated by general debility—by favouring absorption in general, and consequently the disappearance by absorption of the fluid effusion in the part—particularly the serous, inasmuch as it is that portion of the blood which they tend to diminish.

They are especially of service in affections of the head, having a marked derivant effect on the brain, as well as on the upper parts of the body in general; the pallor of the countenance which follows purgation is familiar to all; as also the lightness and giddiness of the head, which are apt to ensue by continuance of its use. On the other hand, there are cases in which they cannot prove but injurious; as in compound and comminuted fractures, where total absence of motion is by far the most important part of the treatment; and in inflammatory affections of the bowels themselves—when, by effecting both increased determination of blood and exaltation of the organ's labour, they could not fail to injure grievously.

Purgatives are at first usually of a drastic and searching nature, afterwards simple and saline; their object being first to evacuate thoroughly, as well as to promote copious secretion, more especially from the liver; afterwards merely to keep up a moderate exhalation from the mucous membrane. If need be, they may be occasionally assisted by enemata; or these may even sometimes occupy their place, when the stomach proves especially resentful of intrusion.

4. In some cases, *emetics* are useful, at the outset; clearing the stomach, encouraging secretion from the liver, interrupting assimilation, and favouring perspiration; also, as auxiliaries to expectoration they may prove highly advantageous. This class of remedies are of course inexpedient, when there already exists marked determination of blood

to the head: the effort of vomiting would be very dangerous. On the other hand, they may be expected to prove especially beneficial, in those inflammations which are preceded and accompanied by obvious biliary and stomachic derangement; in most cases of erysipelas, for example, there is no better commencement of the treatment than full and free emesis.

5. *Mercury*.—The mercurial is often the preferable form of purge at the outset of treatment—calomel, followed by jalap, for example; causing copious exhalation from the intestinal mucous membrane, promoting a free flow of bile, and—if that secretion be part of the fuel by whose intra-combustion animal heat is maintained, as chemistry has of late hinted—obviously tending to lower the febrile increase of temperature. But it is not as a purgative that mercury is chiefly antiphlogistic; not when it passes quickly through, but when it is retained in the primæ viæ, absorbed thence into the system, and lays hold of this, exerting on it a specific effect; the systemic seizure being usually indicated by fœtor of the breath, tenderness of the gums, and rawness of the mouth, which, if the introduction of the mineral be continued, advances to complete salivation. But as it was not the purgation, so is it not the salivation which we usually desire. Mercury, gradually introduced into the system, seems to exert a tonic effect on both the extreme blood-vessels and the lymphatics, that is on the exhalants and the absorbents; thus preventing or limiting impending effusion, and at the same time expediting the removal of that which has been already exuded. The affection of the gums is not of itself valuable, but only as showing that the impregnation of the system by the mineral is so far advanced, as to be equal to the effecting of this result—truly antiphlogistic. Besides, mercury is supposed to act directly on the blood, affecting the red corpuscles, as well as assisting in removal of the anormal proportion of its fibrin.

From its power of at once limiting and removing effusion, it is very plain how valuable must be its administration in all inflammatory affections of important internal organs, whose functions must seriously suffer by any considerable change of structure, however temporary; or when texture is extremely delicate—even slight effusion producing much disorder, and hard to be recovered from—as in the iris, and synovial membrane. When such parts are becoming truly inflamed we give mercury with much eagerness, desirous that its constitutional effect should be both speedy and complete. But he is a sadly thoughtless and reprehensible practitioner who throws in mercury with a loose hand and a careless eye for inflammations in general—real or supposed—regardless of the risk thereby encountered of hopeless ruin to the system at no very distant date, by the remote consequences of wanton and uncalled-for mercurialism. It is fortunate for us that such risk need not be dreaded by the wary surgeon, who not only gives no mercurial course unless such be demanded, but also inquires diligently into the circumstances connected with that demand, ere he admits it to be just and true. When satisfied on this point, he hesitates no longer; but proceeds to his duty of saving vitally important texture and function at all hazards, comforted by a belief, well-grounded on experience, that,

by such inflammations there is engendered a tolerance of mercury, both present and future.

The best form of exhibition is calomel, usually combined with opium, in the form of pill; two grains of the former, with half a grain of the latter, repeated every hour or every two hours, according to the haste with which we desire to affect the system. The opium prevents the mercury being wasted as a purge, and insures its internal reception by absorption, while itself has a beneficially sedative result on both the nervous and vascular systems. It has lately been proposed—in accordance with a laudable desire to obtain the constitutional effect at the least possible cost of mercury—to give calomel in very minute doses, often repeated; as the twelfth of a grain every hour; absorption being supposed to take place very readily and fully from minute doses—as is exemplified in the internal use of arsenic. Such caution is much to be commended, and such doses are highly allowable, in cases of no great urgency, either as to intensity of action or importance of texture involved; but the old experienced dose, as above stated, is far more trust-worthy in the true inflammatory emergency. Should calomel and opium be found to disagree, a convenient substitute may be found in the *hydrargyrum cum cretâ* with Dover's powder. When it is desirable to affect the system with extreme rapidity, or when the ordinary mode of exhibition is peculiarly tardy, the desired result may be accelerated by rubbing in a mercurial ointment or liniment on the inside of the thighs, in the axillæ, or over the part affected.

Mercury, however, let it ever be remembered, is only subsidiary and second to bleeding as an antiphlogistic. The intensity of the vascular action must be first broken by loss of blood; the remainder is then well dealt with by the mercury. But should the latter go single-handed to the contest, it is sure to fail; harm is done instead of good; the inflammation and its accompanying fever are both augmented, as can be readily understood, when it is borne in mind that the direct effect of the medicine is stimulant or tonic to the capillaries.

The time, then, at which we are to commence the exhibition of mercury for antiphlogistic purposes is after blood-letting; we desist when the gums have been "touched," as the ordinary phrase is, showing the attainment to systemic seizure; or we may often cease from its use at a still earlier period, the symptoms which demanded it having satisfactorily given way. Should the disease, on the contrary, prove obstinate, even after ptyalism has been induced, the mercury may be cautiously resumed, so as to maintain this until recedence or change in the symptoms occur; but in no case of mere inflammation is full, far less sustained, salivation at all necessary.

In all cases, before enjoining its administration, it is well to inquire as to the existence or not of idiosyncrasy regarding it; whether the patient is easily affected, or otherwise; whether liable to the troublesome eczema, or to the dangerous erethismus.

Should mercury both gripe and threaten to purge, notwithstanding combination with opium or hyoscyamus, it is well that the doses be given in some bulky vehicle. In non-inflammatory cases—as certain forms of the venereal disease—such disagreeable tendencies are

readily avoided by giving the mercury immediately after the ordinary meals.

Locally, mercury is of use, in the form of plaster or ointment, applied to the part affected; but the proper time for its employment is still later than that of the internal exhibition. It is meet to oppose, not the action itself, but rather its results on texture. All acuteness of action must have been previously subdued by the earlier and more appropriate remedies; and then mercurial inunction, by its tonic and stimulant effect on blood-vessels and absorbents, may happily restore the tone of the former, as yet dilated and weak, and prone to continuance of effusion; while it rouses the absorbents to an increased duty, that effusion may be removed, and normal condition of texture restored. But at an earlier period, the same application, now so beneficial, could not fail, by stimulating the blood-vessels, to aggravate the action and the changes of structure to which it tends.

6. *Opium* we have already seen to be of use combined with mercury, as an auxiliary towards the constitutional effect of the latter remedy, by preventing purging. Its own direct influence is also favourable. But, like mercury, it must follow bleeding. Given before loss of blood, it still further dries up general secretion, seems to increase the vascular excitement, and aggravates the inflammatory symptoms, both general and local—especially the former; not unfrequently inducing alarming delirium. Whereas, following blood-letting, the sedative effect on the circulation which this had induced is maintained, the general nervous system is soothed, pain in the inflamed part is assuaged; and, with the combination of mercury, ipecacuanha, or antimony, secretion is not opposed. The patient, previously tossed on a sleepless couch, sinks into a profound and sweet slumber, and awakes refreshed; with a soft moist skin, and with his troubles, both local and general, wondrously abated. After severe bleeding, we have already seen how a full opiate is of much service in allaying or altogether preventing nervous reaction; but, when much blood has been lost, the dose of opium, although full, should always be very guarded; soothing is wished, not thorough narcotism; yet, under such circumstances, the latter is not unlikely to be induced, directly perilling existence, should the opiate be imprudently repeated at too short intervals. Narcotism may be also untowardly encountered, by repose in a common belief which we humbly conceive to be an error; viz., that when opium is to be given by the rectum, a much larger dose is necessary than when it is administered by the mouth. The dose should be the same; certainly not greater. Its absorption by the mucous membrane of the lower bowel is just as likely to be speedy and full, as that by the stomach; perhaps more so, seeing that, as Dupuytren has observed, the function of digestion may interfere obstructingly in the one case, but cannot in the other. I, of course, assume that the lower bowel is free from accumulation, and that the fluid opiate is brought into direct and general contact with the lining membrane. With due precaution, however, the administration of opium by the rectum is a valuable substitute for its ordinary mode of exhibition, when there happens to be much nausea, the stomach rejecting all ingesta.

During inflammation of internal parts, attended with excruciating pain—as in peritonitis—opium must be given in larger doses than usual, and oftener repeated; for not only is there a tolerance of the remedy created by the disease, but such pain must be subdued at all hazards, otherwise it will inevitably exhaust the powers of life. Still, however, the opium must follow bleeding, not precede it. In such cases it may be given pure, the anodyne effect being the paramount indication. But, for ordinary antiphlogistic purposes, it is combined with mercury, antimony, or other auxiliaries; and thus is avoided the disadvantageous tendency, which it is otherwise apt to evince, of opposing secretion.

In inflammatory affections of the brain or its envelopes, or when these important parts threaten to become secondarily involved, opium must be either abstained from, or given cautiously in combination; for it tends to induce determination of blood to the head. If altogether disused, its place may be occupied by conium, which has a directly opposite—derivant—effect in regard to the cranial contents. If employed, let it be combined with antimony, given watchfully, with the head well raised and kept cool. Such antimonial combination is extremely useful in all cases of cerebral excitement, which we are very anxious to subdue, and against which we are afraid to employ opium, alone and unmodified in its effects.*

7. *Antimony* is a valuable antiphlogistic; usually given in the form of tartrate. Its effect varies according to the amount of dose. An aqueous solution, containing a sixth of a grain, repeated every two hours, will produce diaphoresis; thereby overcoming the arid state of the skin, relieving the capillaries by restored secretion, and undoing one of the most characteristic symptoms of inflammatory fever. And if diaphoresis be especially desired, its occurrence may be greatly facilitated by the hot bath, partial or general. A quarter of a grain similarly administered, not only proves diaphoretic, but occasions nausea, and exerts a sedative influence on the general circulation; and that independently of previous loss of blood. Of course it will prove a more powerfully depressing agent when blood-letting has been premised; but it is important to bear in mind that such precedence is not necessary to its antiphlogistic effect, as in the case of mercury and opium—for from the first it seems to diminish the tonic of the vascular system; and, consequently, in many inflammations, neither themselves very intense nor seated in important parts, antimony single-handed may effect the desired depression, leaving the veins unimpoverished of their all-important contents. In the dose of from half a grain to a grain, repeated every two hours, besides the ordinary effects of the medicine—sedative and diaphoretic—a still more truly antiphlogistic influence, somewhat resembling the mercurial, is said to be exerted; opposed to general exaggeration of arterial tone, favourable to absorption, and so tending to

* *Rx.*—Tart. antimonii, gr. ii.—gr. iv.
Tinct. opii, ℥i.—℥ii.

Aquæ fervidae, ℥viii. ℥l.

Sig.—A table-spoonful every two hours.

restore normal texture and function; and this last effect is farther said to be most distinctly shown in inflammation of vascular internal organs. It may be supposed that thus employed, antimony is only a duplicate of mercury. But it is not so; the effects of calomel—more especially when sakelessly given—are insidious, protracted, and bode evil for the future; those of antimony are only temporary. When, therefore, a case occurs in which either medicine may seem to be equally able to relieve the part efficiently, antimony is decidedly preferable; in such circumstances it is the superior of mercury, not its mere equivalent—giving similar benefit from its use, yet leaving no lurking danger behind. Again, both may be advisable remedies for one disease; each employed at its own appropriate period of the case. Thus in pneumonia, full doses of antimony are most likely to relieve in the early stage, while effusion is still soft, recent, and of more or less fluid consistence; while at an advanced period, hepatization being completed, greater reliance may be placed in the effect of mercury, if the constitutional symptoms have subsided. For this seems not only to favour absorption of recent and fluid deposit, but to be capable of undoing that which is of older date, and some way advanced in organization; softening it, and so fitting it to become the prey either of absorption or of ulceration.

In this country, the doses of antimony are seldom made higher than those already specified; but on the Continent, ten grains and more, repeated, are not unfrequently indulged in. But it remains yet to be shown whether such heroic measures are in any respects superior, and not in many inferior, to the ordinary mode and amount of administration.

It is to be remembered that a certain tolerance of the remedy is doubtless engendered by the inflammatory process; and consequently the patient is to be warned that though the first dose or two may induce nausea and even full vomiting, he is not to be discouraged thereby, but to persevere, as the sickness will soon and certainly cease. When tolerance is suspected to be incomplete, however, or when it is especially desirable that no actual emesis should occur, a few drops of laudanum, or of the solution of the muriate of morphia, may be given with each of the two or three first doses of the antimony; or these may be combined with from five to ten drops of the dilute hydrocyanic acid.

The happy effects of a combination of antimony with opium, in cases of disorder of the cerebral functions, without inflammation within the cranium, yet with a suspected tendency thereto, have been already noticed.

8. *Aconite* and *Belladonna*, in addition to their anodyne properties, exert a directly sedative influence on the general circulation, and may consequently prove useful in this respect as antiphlogistics; the former, especially, shows great power in lowering and softening the pulse. Both, however, must be given in small doses, and with caution, lest a too great depression of the vital powers ensue. Their use has lately been much extolled, in the inflammatory stage of erysipelas; and the former has for some time enjoyed considerable reputation as a successful opponent of rheumatic affections of an inflammatory nature.

9. *Colchicum*, also inducing a sedative effect on the circulation, and

tending to cause increased exhalation from the mucous membrane of the bowels, as well as very marked increase of secretion from both the liver and the kidneys, is plainly qualified to prove highly available as an antiphlogistic. In full doses, continued, it is supposed to exert a specific effect on the part, freeing it from impending change of structure, as do mercury and antimony. Being farther endowed with the property of eliminating urea from the system, by its agency on the kidneys, it is especially appropriate to inflammatory affections of a rheumatic origin and character. The wine of the seeds, cautiously commenced and steadily increased, is the favourite form of the remedy.

Diuretics in general, by their evacuant effect, may be classed among the not unimportant antiphlogistics; especially their simplest forms; nitrate of potass; bitartrate of potass, sweet spirits of nitre, acid and alkaline drinks, &c. They of course are exceptionable, when the secreting organ, the kidney, happens to be the seat of the inflammatory disorder; for by their use under such circumstances, the paramount indication of obtaining rest, actual or comparative, for the affected part, would be most palpably contravened.

10. *The antiphlogistic regimen* is not the least essential part of the treatment. It comprehends 1.—*Diet*. This is obviously to be given but sparingly, and invariably of a non-nutritious character, so long as the action remains unbroken; and even then the return to more generous food must be most gradual and cautious. Fortunately, loss of appetite and loathing of food are usually tolerably prominent during the inflammatory progress; it is during the period of its decline that precaution is necessary, in denying the returning appetite, or deceiving it by unproductive materials. A hearty meal, untimely indulged in, has often reinduced all the mischief. Drink should be bland, simple, and cooling; given often and in small quantities, rather than in copious draughts; for the latter, unless productive of diaphoresis or diuresis, are apt to injure by tending to plethora. Thirst, however, is usually a most troublesome symptom of the inflammatory fever, and must be assuaged, with due precaution. Acidulous drinks are usually the most refreshing; and of these it is well to have some variety, as the most palatable is apt to become distasteful after a time. Diluted solutions of nitrate of potass, and of the alkalies combined with vegetable acids, are not only grateful to the parched mouth, but likewise relieve the fevered system by favouring secretion—therefore not unjustly termed Refrigerants. 2.—*Rest* of the body, with *quietude* of mind, is plainly an important indication, and ought to be fulfilled so far as circumstances will permit. Restlessness and jactitation are symptoms of the constitutional disorder, as also tendency to apprehension, anxiety, and general disquietude of mind, and consequently to a certain extent inevitable. The general antiphlogistic management, by removing their cause, is the most effectual means of removing them; but some time is necessary for this; and in the meanwhile much may be done by many little attentions on the part of the attendants. 3.—*Air*. When it is remembered how essential is a free supply of good air to the maintenance of a healthy state of the blood, and how imperfect aeration leads to obstruction of the capillaries, systemic as well as pulmonary, the necessity for

due ventilation of the sick-chamber becomes very apparent, during the progress of inflammatory disorder—a process so intimately concerned with capillaries and their contents.

Local Treatment.—1. *Rest.* To procure as complete rest of the inflaming part as circumstances will possibly permit, should be the first care of the surgeon; and to maintain it undisturbed, his efforts should be directed throughout the whole period of treatment. Availing himself of an important advantage which he has over the physician; namely, that in surgical inflammations of external parts, this valuable indication may be often fulfilled, while it can only be effected partially, if at all, in the case of an internal organ—as the head, lungs, or kidney. Place an inflaming joint in a state of rest, so soon as you are called, and maintain its immunity from motion undisturbed, by splints or otherwise, and you will not require to take largely from the rest of the antiphlogistic catalogue; whereas permit its play, voluntary and involuntary, to remain uncontrolled, and leeches, cuppings, blisters, time, may be all freely expended, without securing an equally satisfactory result. And the same parallel may be drawn in regard to every part truly inflamed.

2. *Position.*—Not only should the part be put and kept at rest, but it should also be placed and maintained in such a position as to favour the antiphlogistic result. The knee, for instance, is bent, so as to relax the muscles implicated, thereby relieving tension and diminishing the risk of involuntary spasmodic movement; while the limb is also elevated, in order to favour venous return, and retard the arterial influx. The inflaming part having been thus attended to, as regards both rest and posture, we are in a favourable position for proceeding to local blood-letting, in the manner and on the principles already detailed.

3. *Cold.*—With some it is still an unsettled point whether heat or cold be the preferable application to an inflamed part; the question being usually left open, to be determined either by chance or by the feelings of the patient. I believe heat and cold to be both valuable antiphlogistics, but that each has its appropriate period for use, and that either employed out of its own proper time and place will invariably do harm. The virtue of cold is chiefly as a prophylactic, diligently and carefully employed during the period of incubation. Thus, after the infliction of an incised wound, we are anxious to prevent inflammation, or at least to retard and limit its occurrence, and have recourse with this view to the continued application of cold in the manner formerly described. Should we succeed in averting the inflammatory process altogether, we gradually cease from the application. And should the inflammatory process fairly set in, notwithstanding our efforts to the contrary, I consider it to be equally our duty to desist; the time appropriate for cold has passed, and if its use be persevered in, harm will follow. For it then opposes exudation, and so prevents the natural relief of the over-burdened vessels; it promotes contraction of the parenchyma, rendering this less yielding, than it would otherwise be, to the effusion which does occur, and so favours tension and consequent aggravation; and during the farther progress of the action it must, by its directly sedative influence, depress the vital power of

the part—so favouring the supremacy of action over power, and hurrying on the former to its extreme results, of suppuration, ulceration, and gangrene. During the rise of the inflammatory process, it may induce, or seem to induce, abatement of one symptom—the heat; but in all other respects the part will sustain injury by its use. During incubation, be diligent in its application, but desist so soon as the signs of inflammatory accession have become apparent.

• Another precaution is necessary. Let not the cessation be abrupt, but gradual; from cold to cool, from cool to tepid, from tepid to warm, from warm to hot; otherwise the second or reactive effect of cold, intensely favourable to vascular action, is inevitably produced. During the use of cold, it is its first or sedative effect which we desire to maintain; while departing from this, its fitting time having elapsed, we should beware of inducing the second, which may of itself originate perverted vascular action, and is certain to accelerate its advance if already begun—more especially should the power of the part happen to be even temporarily depressed.

When action has fully subsided, and effusion, too, has greatly disappeared, the part still, however, remaining weak, lax, and swoln, with its blood-vessels in a congested condition, cold again may become serviceable; but not intense—otherwise power might be still farther reduced—and accompanied by a mechanical influence, as in the form of douche; producing a general astringent effect on the part, somewhat stimulating the absorbents, and imparting tone to both blood-vessels and parenchyma. Cold thus is found to be of use at both extremes of the inflammatory process—just before its accession, and subsequently to thorough recession; but during the actual existence of the action, it is inapplicable.

4. *Heat and Moisture*, plainly less suitable than continuous cold during incubation, are as plainly preferable during the inflammatory process. They are grateful to the feelings of the patient, allaying the sensations of pain, heat, and tightness. They favour effusion from the vessels, whereby natural relief is given to the oppressed local circulation; they, at the same time, relax and promote the yielding of the parenchyma, to receive accommodately this copious exudation; not only are the vessels relieved, but the texture is not incommoded; there is no tension, and, consequently, no increase of throbbing and pain, with aggravation of the disorder. Also, by relaxation of both blood-vessels and parenchyma, combined with relief of the former by exudation, the stagnating tendency of the blood is opposed, and renewal of the circulation favoured. It is very obvious how thus heat and moisture tend to a favourable result during the crescent process, but it is equally clear that, at a subsequent period, during the decline, their use cannot be continued without disadvantage; for the acute action over, and its results remaining, that which tends to continue effusion, to prolong the dilated condition of the vessels and relaxation of the surrounding parts, is opposed to resolution, and positively injurious. Let the application, then, be diligently employed during the active stage, and gradually abstained from so soon as the process of decline has been fairly established. There is little doubt that protracted chronic action,

with tedious suppuration, is often attributable solely to injudicious continuance of poultices and fomentation.

The form of application may be either that of epithem or fomentation. The latter is more generally available. A piece of flannel, or sponge, wrung out of hot water, is applied, as warm as can be conveniently borne, and replaced by a substitute so soon as the heat begins sensibly to abate. This is continued for half an hour, or more, and repeated at longer or shorter intervals, as circumstances may seem to demand; the part being in the meanwhile softly dried, and covered either by a poultice or by some dry simple investment—as a piece of linen, wadding, or soft flannel. It is well, sometimes to medicate the fomentation; chamomile flowers, with heads, of poppy, for instance, may be put into a flannel bag, and used instead of the common flannel or sponge. The patient will be inclined to place more faith in such a focus than in mere hot water, and, besides, positive benefit is also derivable from the anodyne qualities of the medication. When the perverted vascular action is on the surface, and attended with much pain and increase of sensibility, the warmth and moisture may be still farther medicated; thus, in some forms of erythema, and especially in inflammatory affection of the superficial lymphatics, much relief is obtained by keeping the part constantly moistened with a solution of acetate of lead and opium, in the proportion of two grains of each to the ounce of water; a sedative and anodyne effect is thus superadded to the ordinary tendency of fomentation. The form of epithem is sometimes inapplicable, the part being wholly intolerant of weight and pressure, as in acute affections of the eye. But when moderate weight is not objectionable, and the continued application of heat and moisture is desired, the ordinary poultice is very suitable in many cases; made light, soft, free from grease and all irritants, actual or possible; and renewed as often as maintenance of sufficient temperature requires. Nothing is better, for example, in an inflaming ulcer, a forming boil or abscess, or a sloughing bruise. But there are many cases, on the other hand, in which it may be well superseded by a more elegant and convenient substitute—lint, folded double, or quadruple, dipped in warm water, laid on the part, and covered by a larger piece of oiled silk, which retains the heat and moisture, and prevents soiling of bed and body linen. In ordinary inflaming wounds and ulcers, for example, this is infinitely the preferable form of application; more easily obtained and renewed, less odorous, less heavy and cumbrous, less apt to irritate by degeneration, than the common poultice. Or a third form of application may be employed—steam, as recommended by Dr. Macartney. It may be applied by means of an ordinary vessel; or, what is better, an apparatus such as recommended by the doctor, may be employed. A lamp, acting on a small tin vessel, filled with water, generates steam; and this is conveyed directly to the part through a woollen hose, twelve inches in diameter, kept open by elastic hoops, and about three feet in length to prevent scalding. Perhaps the only objection to this form is, that the suitable means and appliances may often not be at hand, while hot water and flannel, for ordinary fomentation, can always be obtained, even on short notice.

5. *Nitrate of Silver* has two modes of action, according to the severity of its application. 1. When passed lightly, in the solid form, over the part previously moistened, the surface, if subsequently exposed to atmospheric influence, becomes black, dry, and hardened; or the same result may be obtained by the use of a strong solution. At the same time, a mitigation of all the ordinary symptoms of the inflammatory process is almost invariably evinced, if the action be neither very active nor advanced, and situated not deeper than the *cutis vera*. In simple erythema of the fingers, for instance, often nothing more is requisite, except local rest and constitutional care, to achieve speedy and satisfactory resolution. The effect is plainly sedative and antiphlogistic, acting directly on the part; but the *modus operandi* seems to be as yet shrouded in mystery. The blackened and otherwise altered epidermis, doubtless, affords an additional and very effective protection to the tender dermis, from atmospheric influence and other external stimuli, and thus one important benefit is obtained; the rest we cannot trace; yet we are not the less glad to avail ourselves of the fact, undoubted, though but imperfectly accounted for, that nitrate of silver, thus lightly used, has a purely antiphlogistic effect on inflammatory affections of a slight and superficial kind.

Iodine, in solution, pencilled frequently on the part, exerts a somewhat similar influence; but, on the whole, it is probably inferior to the nitrate of silver as a direct local antiphlogistic, although it may be, under some circumstances, a very convenient substitute. In red, painful swellings of the toes, for instance, often associated with irritable corns, and in similar affections of the skin at the roots of the finger nails, so common in washer-women—the external use of iodine seldom leaves any thing to be desired.

The light use of nitrate of silver may be also rendered available in circumscribing perverted vascular action, when superficial and disposed to spread—as in erythema and simple erysipelas. It is applied in substance to the sound skin, about two inches from the erythematous border, so as to form a belt surrounding the extending redness on all sides, and about an inch in breadth. In very many cases—other suitable repressing means being of course not neglected—the action advances up to this line of circumvallation, and fails to surmount it; thus becoming arrested within its confines. Care must be taken, however, not to produce vesication by too severe an application, otherwise the effect will probably be to hurry on the spread of the redness, and favour its transgression of the limits which were intended to fix its arrest.

2. Nitrate of silver may be applied firmly and long enough to produce vesication; an excellent means of counter-irritation, to be immediately considered; but plainly inapplicable to affections of the very surface, as to them it must prove a direct rather than a counter-irritant. The milder form of application cannot be employed too immediately as regards both time and space—indeed, the earlier and more direct its use, the more likely it is to prove successful—its effect being directly sedative and antiphlogistic; the higher dose, however, effects a plainly contrary result, as the occurrence of vesication abundantly testifies.

6. *Pressure*, like cold, is to be considered rather as a prophylactic, than as a curative agent in inflammatory affections; if employed early and carefully—yet even then the result is problematical. It is quite possible that very gentle, accurate, and uniform pressure may be made on a part about to be inflamed, so as to prevent the first step of the process—determination of blood; or even when that has occurred to prevent the second—dilatation and distention of the capillaries; and that thus the establishment of the process may be, as it were, mechanically obstructed. But I confess that it is much more easy for me to imagine, that the pressure is not so skilfully and successfully conducted; that determination to and subsequent distention of the capillaries do take place, at least in part; that the inflammatory process does begin, prophylaxis having failed to be complete; and that continuance of the pressure then can only occasion evil, by creating much tension, and so greatly aggravating the disorder.

During the progress of the true inflammatory process, the use of pressure, however uniformly applied, must prove even more injurious than that of cold applications, and for similar reasons.

The time for the right employment of pressure is after declension of the action; change of structure only remaining, by reason of resolution being as yet incomplete. Then it is one of our most valued and efficient means of stimulating the absorbents, and so removing effusion; yet even then its use must be at first cautious, lest it should over-stimulate the blood-vessels as well, and induce an inflammatory reaccession. It is applied by means of plaster, splints, or simple bandaging.

7. *Counter-irritation*, likewise, is not to be employed, until all acute action has fully subsided. During advance of the inflammatory process, as yet unbroken by the suitable means, the induction of a new action by a new stimulus, even at some distance, not only fails to afford relief, but usually aggravates both the local and general disorder. The question of *time*, therefore, is an important consideration; counter-irritation being the opponent not of acute but of chronic action, and useful in getting rid of the results of either. *Site* also is important. Applied to the part itself, acute action is induced therein; an occurrence invariably untoward, unless when we wish for either destruction or thorough change of structure. And a somewhat similar result is likely to ensue, if the application be made in the immediate vicinity of the part affected. To be beneficial, and even safe, the action artificially induced must be at some distance from the site of the original disorder; and yet not too far removed, otherwise the derivant effect it is intended to produce may fail to operate sufficiently in the right quarter. There is no more valuable remedial agent than counter-irritation; none more frequently employed with the best results; but it must be rightly placed and timed; not too soon, nor too near, nor yet too far away.

Remembering what was formerly stated in regard to metastasis, we can readily understand the mode whereby counter-irritation acts beneficially on an inflaming part. The effect of the new action is to remove, or at least diminish, the old. Marked derivation is produced. Blood passes from the original to the recent quarter of excitement and deter-

mination; the skin, comparatively unimportant, undergoes a slight and manageable amount of the inflammatory process; the deep part, comparatively important, is thereby relieved more or less effectually from what endangered both texture and function. The relief is analogous to that of local blood-letting; less powerful at the time, but by continuance ultimately more effectual; not directly sedative to the system, as well as to the part, as is blood-letting, and therefore capable of being continued with all propriety; both remedies take blood from the seat of inflammation, but by the latter means spoliation of the system attends on derivation from the part; by the higher grades of counter-irritation a certain loss is also sustained in the form of serum, liquor sanguinis, or pus, but that is comparatively trifling, and capable of being borne with impunity. It must ever be remembered, however, that induction of the external and derivant action is likely to prove directly irritant to the system—more especially if that be peculiarly susceptible of impression by reason of an irritable habit—during persistence of acute inflammatory fever; as well as directly irritant to the part, during the existence of acute local inflammation. For, in the former case, the febrile disorder receives a fresh exciting cause, and obeys it; in the second, the inflammation being yet unbroken in the part, its stagnant and sluggish blood cannot be roused to effective derivation—its own circulation must first be restored to freedom—and the part is not bettered, but the contrary, by having to sustain two co-existent inflammatory processes, at but a little distance apart, not unlikely to unite their forces, and conjointly to tend further towards evil.

Counter-irritation may be varied in grade, form, and mode of application. 1. *Rubefacients*, constitute the slightest class, and are simple counter-irritants. They induce hyperæmia in an external part, and are of use to relieve a somewhat similar condition elsewhere; they bring blood to the surface, but do not thence discharge it; it still remains within the general circulation. Moderate heat, mustard, and various stimulating embrocations, may be noticed as familiar examples. Of these, the mustard is probably the most frequently employed; in the form of epithem, termed a sinapism, or mustard poultice; made by spreading, within the folds of fine flannel or muslin, a thick layer of mustard-flour, beat up into a pasty consistence with vinegar,* and moistened and warmed before application. It is kept on until redness is fully established in the skin; and for this purpose no definite period can be assigned, as there are many individual peculiarities in this respect; some patients retaining such applications for several hours, with comparative impunity, while others are almost wholly intolerant of them, by reason of their proving acutely irritant both locally and generally. In children, the time of their application should be invariably brief; as they are not only apt to vesicate, proving more than mere counter-irritants; but likewise not unlikely to induce even gangrene,

* The chemist says that vinegar is no good solvent of the active principle of the mustard; but experience assures us that it makes a most efficient sinapism.

when imprudently or negligently employed. The simple counter-irritants are adapted to the milder and less advanced examples of the inflammatory process; active congestions, for instance, in the throat and air-passages, often yield readily to such measures, when preceded by leeching and other antiphlogistics. Or the antiphlogistics may be with safety omitted, when the process is just only begun; no remora of the local circulation being as yet even indicated, the derivant effect may be instant and complete, at once relieving the threatened texture. Not a few sore throats are daily aborted by the common sinapism, assisted perhaps only by a purge, a sweat, and temporary starvation. As a general rule, however, it is not the less to be inculcated—in regard to the higher grades of the process, and most especially in regard to true inflammation—that even the simplest class of counter-irritants are not to be employed until a comparatively late period, when all activity of morbid action has been fairly subdued by other and more suitable means. Nor should they ever be used, without much caution, in either children or adults of a peculiarly irritable habit; for in the latter they are apt to have a constitutional effect, the reverse of antiphlogistic; and in the former it is possible that the cure may prove worse than the disease.

Dry-cupping may be ranked among the simple counter-irritants; that is, the glasses being applied in the ordinary way, but without the use of the scarificator. Blood is brought to the surface, and there retained, during the application, and for some time afterwards; and the effect is obviously derivant. It possesses one advantage, important in irritable habits; namely, that the desired result is at once obtained, without antecedent irritation; the blood is brought simply to the surface, without any previous vascular excitement there.

2. *Vesicants*, both counter-irritate and prove evacuant; not only bringing blood to the surface, but also discharging thence more or less of its thinner part, at first purely serous, afterwards resembling the ordinary liquor sanguinis. Heat of considerable intensity; cantharides, in the various forms of blistering paper, tissue, and liquid; nitrate of silver rubbed hard on the part, till pain is felt, the roots of the hairs look blue, and the general colour of the skin begins to change—are familiar examples. They are a more powerful class than the rubefacients, and consequently adapted to oppose a higher grade of action. Their efficacy is especially admitted in regard to the final subjugation of inflammatory affections of the serous and synovial membranes. Often, under their use, the embers of acute action are quickly extinguished, and effusion also speedily disappears; it may be that they stimulate the absorbents, as well as relieve from all remaining perverted vascular action; or it may be that, by fulfilling only the latter indication, the liberated texture is enabled to resume its normal function, and so work out its own cure; or the counter-irritant, by establishing a brisker circulation in the vicinity of the part, may so expedite disappearance of the effusion, by absorption of the more fluid portion into the increased venous return. The simple form of the cantharides is apt to irritate the kidneys, as evinced by strangury, sometimes se-

vere. In affections of the genito-urinary system, therefore, more especially of the secerning glands themselves, we will either prefer another vesicant, such as the nitrate of silver, or employ the cantharides with much caution; giving bland mucilaginous drinks, and using one of the "*telæ vesicatoriæ*," rather than the ordinary plaster; as these profess to avoid this casualty, and often keep their promise. If very rapid vesication be desired, ammonia in a concentrated form, or boiling water, or a smoothing-iron removed suddenly from boiling water may be employed; or the part may be covered with alcoholic fluid, and then set on fire.

3. *Pyogenic counter-irritants* prove still more highly evacuant, by establishing from the artificially inflamed surface a more or less copious discharge of pus—that is, of the most important part of the blood for nutritive purposes, whether normal or perverted—its liquor sanguinis. An ordinary blister may be converted into this class; at first it discharges pure serum; this becomes less in quantity, and of greater consistence, containing a certain amount of fibrin, and gradually dries up, the part recovering with desquamation; the action having gradually passed away. But should the action be continued, either by reapplication of the same cause, the blister, or by the use of some other irritant—as tartar emetic, or savine ointment—the serous discharge is succeeded by a purulent, true inflammation having been reached; and such purulent discharge may be maintained, by continuance of the stimulating dressing. But when we deem it expedient to employ this higher grade of counter-irritation, it is usually our object to obtain discharge of pus from the first.

Tartar Emetic, already found so useful at an earlier period of the disorder, when given internally, now comes to be of service as a local application; in the form either of ointment or of strong solution. Pustules form more or less abundantly, usually of large size, and attended with a great amount of local action. But this mode, though capable of producing much counter-irritation, has its disadvantages. The pustules do not always appear in the place rubbed, and where they are wished; but often at some distance, doing no good, and creating a great deal of unnecessary irritation; in the axilla, for instance, instead of on the arm or side. They are apt to be scattered over a large extent of surface, not concentrating the counter-irritant effect, and consequently comparatively inefficient as regards the seat of disease. From these circumstances, together with a liability of the larger pustular formations to terminate occasionally in gangrene, not very limited, the counter-irritant local effect of this application is apt to be merged in the general irritant—an event not atoned for by absorption of the antimonial into the system. In very many cases, therefore, we prefer a more mild and manageable agent. *Croton Oil*, pure, or diluted with some simple oil, and coloured to prevent mistake, produces a very copious eruption of minute pustules, which cluster closely together, and almost invariably limit themselves to the part rubbed; and its effects may be varied from mild to grave, according to the intensity and duration of its use. *Nitrate of Silver*, too, in addition to its simple anti-

phlogistic and vesicant effects, may be made of pyogenic virtue, by rubbing; in the form of ointment, ten grains to the ounce; pustules follow, of a manageable and efficient kind—said to be very useful in the more chronic affections of the synovial apparatus of joints.

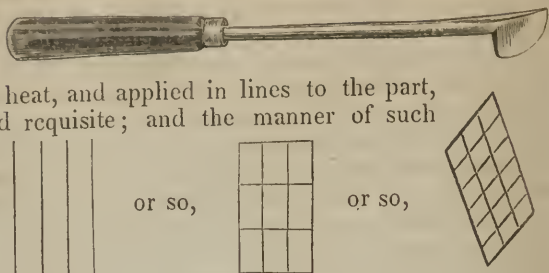
A *Seton* affords a more copious and constant supply of purulent matter than any of the pustular agents. It consists of a wound, chiefly subintegumental, kept open and discharging by the presence of a foreign body lodged in its track. The integuments are pinched up, and transfixed by a bistoury, or by a broad needle made for the purpose; to the eye of the needle, or to the eye of an ordinary probe which is made to follow the withdrawal of the bistoury, a ligature is attached; to the ligature is connected a skein of silk or cotton, intended to lodge in the wound; by the passing of the ligature its lodgement is effected; and by securing the ends in a firm knot, it is securely retained. Poultices and fomentation are applied, during the first few days, until the inflammatory stage has in a great measure passed by, and free suppuration been established; then tepid water dressing, protected by oiled silk, will prove a convenient substitute. The foreign body is moved once or twice a-day, so as to favour cleanliness by preventing lodgement of discharge, and by irritation to keep up a sufficient action for the discharge's maintenance. If an increased amount of irritation and discharge be desired, the foreign substance may be smeared with some stimulating ointment, or soaked in some acrid fluid, before replacement after the cleansing manipulations. But instead of the skein of silk or cotton it is in general much better to employ a caoutchouc tape; which is to be had, manufactured for this purpose, of various dimensions; by absorbing no discharge, it greatly favours cleanliness and absence of unpleasant odour, and besides remains long entire, and does not require the painful process of renewal; it is moved to a side once or twice a-day, wiped, and simply replaced. The necessity for discharge, evacuant and derivant, diminishing, the size of the seton tape is made proportionally to decrease; ultimately the last thin shred is altogether withdrawn, and its bed encouraged to close. Sometimes, in the case of large setons of old standing, a clump of red, vascular, angry looking granulations form at one or other extremity of the suppurating track, giving the patient much annoyance by pain and irritation, and sometimes emitting a considerable quantity of florid blood. They are readily got rid of, without removing the seton, by the stroke of a knife or scissors, or by the application of a powerful escharotic, as the *potassa fusa*.

An *Issue* may be established either by the knife, or by an escharotic. In the former case, it differs from the seton in being an open instead of a subintegumental wound. An incision is made, and to prevent its healing, and ensure its degeneration into a suppurating sore, a foreign body, such as a pea, is placed between the margins, and retained by plaster or bandage; the foreign matter of course varying in bulk, according to the extent of the wound and the amount of action with evacuation desired. When an escharotic is used, it may be either potential or actual; the former is the more generally employed; and the *po-*

tassa fusa is on the whole the most suitable. It may be rubbed steadily on the part, until destruction of texture is effected to the desired extent; or a portion is laid upon the part, and retained by plaster, which at the same time is made to protect the surrounding integument, which we wish to leave uninjured; or a slight incision is made, and into that is inserted a portion of paste composed of equal parts of the potass and quick lime. In any way, an eschar or slough is formed, it separates by inflammation and ulceration, and a suppurating sore is exposed on its detachment. This sore may be kept discharging by stimulating applications, either constantly or occasionally employed; or it may be permitted to heal of its own accord, reapplication of the caustic in the same or another part being subsequently made if necessary. During the separation of the slough a poultice is applied; afterwards the water dressing; if healing is to be opposed, some irritant ointment; of which there are many in ordinary use, especially the Unguentum Tartratis Antimonii and the Unguentum Sabinæ. When we wish the evacuant effect chiefly, we keep the original issue permanently discharging—as in many chronic affections of deeply seated soft parts; when we desire to mingle active counter-irritation with copious evacuation—as in ulceration of the articulating hard tissues—we prefer a succession of eschars, bringing repeated inflammatory accessions externally as well as maintaining purulent discharge.

The *Actual Cautey* stands highest in the list of evacuant counter-irritants. In former times it was in much request by the practical surgeon—forming an invariable part of his armamentarium in daily use—and at the hospital visit uniformly found glowing in the furnace, ready for the performance of its accustomed function. But now-a-days it is often supplanted, happily and humanely, by milder and not less effectual means. For hæmostatic purposes the ligature takes its place; for removal of suspected parts the knife is preferred; it is seldom applied, with any view, to the hard textures; in the establishment of caustic issues in the soft parts, it often and justly gives way to its potential substitute. The heated iron was no inappropriate badge of the dark days of our art; and it might well lead to boding despondency in most of us, to find its indiscriminate and frequent use threatening to return. Still, on the other hand, let us not shrink from its employment, cruel and barbarous though it seem, in those cases which we know by ample experience are to benefit more from that than from any other application. I should be very unwilling to depart in any way from the axiom, “*Ad extremos morbos, extrema remedia*;” I would act up to it, and yet I would not exceed it. In advancing destruction of texture in the bones of joints—more especially if deeply seated—all other means of counter-irritation should, in the first instance at all events, give place to the actual cautery; speedy arrest of such action is our anxious desire ere the change shall have proved irreparable, and we are culpable if we do not at once employ that remedy which we know to be most available to that important end. In chronic affection of some of the internal organs also—the kidneys, for example—a cure may be obtained by the actual cautery, after having been denied to all other means.

The cautery may be flat, edged, or globose. The edged form is usually preferred for the purpose of counter-irritation. It is heated to a white heat, and applied in lines to the part, to the extent deemed requisite; and the manner of such lines may be varied according to the whim or taste of the practitioner—so



Such lines are equally effectual as counter-irritants, in all probability, with a broad continuous slough, and on healing leave an infinitely less formidable cicatrix. The applying hand should be heavy enough to penetrate through the entire true skin, so as to avoid the very painful burn which would otherwise result from exposure of the highly sensitive cutis; and it was with this view that we specified the whiteness of the hot iron. Yet the hand should not be so heavy as to lead to the involvement of subcutaneous parts in the separation of the eschar—an unnecessary and unwarrantable sacrifice of texture. For a few hours after the cauterization, cold is continuously applied, to allay the pain, which, under any circumstances, is severe; and afterwards the eschar is covered with a tepid poultice.

It has been advanced by the advocates for an almost indiscriminate use of the actual cautery, in those cases which require purulent discharge from the surface, that it is doubly advantageous, and therefore superior to its potential substitute; in as much as, by the terror which is imparted to the patient's mind, it achieves a sedative effect on the system at large, while the pain with the coming inflammation and discharge are more directly to relieve the part. But they forget that the use of an escharotic in any form, for the purpose of counter-irritation, is only advisable at a comparatively advanced period of the case, when the expediency of a sedative result to the system is very questionable. And, besides, I have yet to learn that it is ever part of the surgeon's duty to strike terror into his victim, instead of winning his confidence, and soothing his alarm and fears.

The *Moxa*, once much in vogue, has latterly fallen into comparative desuetude. It consists of either a cylindrical or conical roll of porous substance, adapted for steady and gradual combustion. It may be made of the down of the *artemisia latifolia*—the substance originally employed; or a very convenient substitute for the Chinese original may be obtained, in fine cotton wadding, carefully dried after immersion in a solution of nitrate of potass, and enveloped in tissue paper, leaving the ends free. It is held in the regular *porte-moxa*, or in the noose of a common wire. One end having been placed over or on the part to be cauterized, the other is set fire to, and the ignition maintained by either the blow-pipe or bellows. According to the distance at which the burning mass is held, the effect may be made to vary from simple redness to actual eschar; and the latter may be in the same way regu-

lated, both as to extent and depth. When applied with any degree of intensity, the pain is great, as can readily be conceived; nor is the patient's alarm and apprehension at all trifling. But one advantage certainly attends its full use; viz., that after combustion is over, the pain very rapidly disappears. The part seems to be killed so thoroughly, throughout the whole thickness of the true skin, that it is incapable of further sensation. If desired, the surrounding skin may be protected, during combustion, by wetted lint; but it seldom altogether escapes injury, and is usually the seat of tingling pain, by and bye aggravated by inflammatory accession. The application of cold water assists in the subsidence of pain, immediately after the application. By this means very efficient and very varied counter-irritation may be effected; and it was long considered a very potent remedy in chronic affections of joints, both of inflammatory and of neuralgic origin. Indeed, it is not easy to understand how latterly it should have become so much neglected, unless indeed it be from the not unnatural disinclination, which most people may be found to possess, to so deliberate and undisguised an application of fire to the most sensitive part of their living frame.

The actual cautery, in whatever form applied, is doubtless a very painful and in all respects severe remedy. In my humble opinion, it was not only much too frequently and indiscriminately employed long ago, but in the present day may be found smoking in the hospital ward oftener than necessity demands, or expediency would warrant. The cases which absolutely require its use are comparatively limited as to occurrence; and for these, in the name of humanity, common sense, and propriety, let it be reserved. Also when employing it, in cases however suitable, let it be borne in mind, that such an application may not improbably prove in itself a disease of no mean importance, as regards its influence on both the system and the part; and its effects ought always to be carefully watched, with this fact in our remembrance. For example, it is a good rule in practical surgery, after having failed with this most powerful agent to arrest the progress of destruction in a joint, not at once to proceed to amputation, even should the hectic seem urgent; but to discontinue the remedy, and wait a little; perhaps the hectic as well as the local disorder may happily decline, a fresh opportunity for other practice may be afforded, and after all the limb may be saved.

Stimulants and Sorbefacients.—These, being latest of application, come naturally last in the order of enumeration. Let us suppose that an intense inflammatory action has been first broken by blood-letting and other sedatives and evacuants; that its subsequent chronic lingerings have been effectually overcome by judicious counter-irritation; the part is then found free from perverted action, chronic as well as acute, but labouring under no little change of structure, from which it is unable effectually to clear itself; or, the task seeming onerous, it is, as it were loath to begin. It is then that this last class of remedies prove highly advantageous; restoring tone to the dilated and weak capillaries, arousing the slumbering circulation to normal vigour, and stimulating the absorbents to an exaltation of their function; it may be,

mechanically supporting the part, and preventing return of both congestion and effusion. If the action have been but transient, such adventitious aid will probably not be required; the part, freed from action of a perverted kind, at once resumes its own, of the normal standard; becomes its own physician; works its own final cure. But in all cases when action has been continued, inevitably bringing considerable structural change, not only is such extraneous assistance expedient, but it is only by a patient continuance of its use that local health can be regained. Friction, simple or medicated; plaster, with or without bandaging; mercury, in the form of either epithem or inunction—are the more common examples of this class of remedies. Their use is invariably to be deferred, until all action is over; they are also to be begun cautiously, and continued warily, lest at any time inflammatory accession should be re-induced. If this be threatened, they should be suspended on the instant, and not resumed until all again is quiet.

When much fluid effusion remains after cessation of action, as in the serous cavities, the best sorbefacients, or promoters of absorption, are those which act upon the system, and evacuate by excretion, especially purgatives and diuretics, pushed as the system will conveniently bear.

Let it not be forgotten that in all cases of true inflammation, especially the more severe, the part long—perhaps always—remains weak; both prone to re-accession of perverted action, and ill able to control or bear up against it; therefore such a part is to be carefully nursed, and protected from the more prominent exciting causes; and, when action has recurred, we should anxiously seek for its timeous and complete arrest.

Now, let it not be supposed, that in each example of inflammation, or even in most, the whole of the items of the foregoing copious catalogue of antiphlogistics are to be employed; that were to enjoin the running of a gauntlet, from which very few frames could escape unbroken. Selections are to be made; and it is in this practical department, that a knowledge of facts triumphs over mere theory—the practitioner tempering and guiding his theoretical knowledge by experience, judgment, and discretion. It can be readily imagined that no definite rules can be laid down on this subject; but the following may be stated in brief illustration. There are very many surgical inflammations—as after-wounds, bruises, fractures, burns, &c.—in the treatment of which none of the higher antiphlogistics are required: the internal use of antimony,* action on the bowels, local blood-letting,

* The following solution will be found highly available for general antiphlogistic purposes in practical surgery:—

℞ Tart: antimonii gr. ii.
Sulph: magnesiæ ℥ ii—℥ i.
Sulph: potassæ et sodæ ℥ i.
Bitart: potassæ ℥ ss.—℥ i.
Aquæ ℞ ii. ℥ i.

A tea-spoonful, or a table-spoonful, or a wine-glassful, may be given every two hours, according as we wish the effect to be slight or otherwise. The circulation is calmed, the skin determined to, exhalation from the bowels maintained, and the flow of urine increased; in short, the result proves sedative, evacuant, and thoroughly antiphlogistic.

fomentation, rest, and attention to position, are perfectly equal to the remedial task; subduing disease satisfactorily, and yet not enfeebling, even temporarily, the general powers. When an important internal organ, however, is being inflamed—as the lungs, kidney, bladder—we are anxious to overcome the evil as soon as possible—as it were at once to cut it down—saving both texture and function; in such circumstances we begin with full general blood-letting, repeating it once and again until the symptoms are satisfactorily subdued. When not only function of the part is important, but its texture also most delicate—the efficiency of function dependent on the integrity of that texture—as in the eye and brain, we practice bleeding with equal alacrity as in the former instance, and follow it up by the free use of mercury; in some cases, full and continued doses of antimony may be substituted for the mercury; and in some, both of these medicines may be employed, as in pneumonia, each at its appropriate period of the case. When excruciating pain attends inflammation of a part, especially if this be an internal organ, after general and local blood-letting pushed as far as the probably already depressed state of general vital power will permit, our principal reliance must be placed in opium; for, at all hazards, such pain must be subdued if possible; as in serious inflammation of the bowels. In rheumatic inflammations, opium, mercury, antimony, are, as accessaries to blood-letting, often secondary to colicium. For the chronic embers of an acute inflammation, counter-irritation is most suitable; and this, preceded by moderate local depletion, and accompanied by complete rest of the part, is most especially effectual in the cure of perverted action which has been chronic from the first. As all vital action, whether normal or perverted, is usually slower in the hard than in the soft textures, to the chronic affections of the former counter-irritation is particularly appropriate. Again, in certain very acute affections of soft parts, we trust chiefly to the lancet and bistoury; as in erysipelas, and its phlegmonous and most intense form.

The peculiarities of treatment adapted to the chronic as contrasted with the acute form of the inflammatory process, are analogous to the differences in the nature of the two affections. As the action and its symptoms are much less urgent, so are the means of treatment less energetic and less truly antiphlogistic—less severely sedative and depleting; and as already stated, when action has been arrested by such mild measures, its final overthrow, followed by gradual restoration of the part to its normal condition, is to be mainly effected by judiciously conducted counter-irritation.

CONGESTION.

Congestion is of two forms, the *Active* and *Passive*.

Active Congestion.—This has been already considered, as a part of the general inflammatory process. It may be a mere preliminary to

the true inflammation; or it may persist as the minor grade, constituting a disease of itself.

Its *causes* are identical with those of the general inflammatory process; and the *symptoms* are such as have been already ascribed to that process, slightly developed. Redness is considerable; heat, swelling, and pain are well marked, yet not intense. Effusion is not so rapid as in true inflammation, and consequently there is little or no tension. By continuance of even gentle transudation, however, structure may be altered, and function interfered with. More or less febrile disturbance may attend; but not of the true inflammatory type.

The *results* also resemble those of the general inflammatory process. Resolution perhaps most frequently occurs, in the way formerly described. Or advance is made to true inflammation, when the minor action becomes merged in the greater. Or the congestion simply persists, and by continuance leads to change of structure. Effusion is partly serous, partly fibrinous. The action, unlike true inflammation, is not incompatible with organization of what is effused; its fibrin is therefore more or less plastic, and threatens by organization to become permanent in its extravascular position. This may induce serious results, sadly impairing function, as in the parenchyma of an important internal organ. Or the issue may be most salutary, as in the healing of wounds and ulcers, more especially by granulation.

If congestion occur suddenly, and texture be delicate as well as vascular, hemorrhage is not unlikely. If on a free surface, as mucous membrane, no harm, but benefit ensues; it is a spontaneous depletion, probably critical, and ought not to be rashly thwarted; to check such a flow prematurely may be virtually to convert, according to circumstances, hæmoptysis into pneumonia, hæmatemesis into gastritis or enteritis, menorrhagia into metritis; that is, preventing resolution, and compelling advance of the perverted action. If in parenchyma the vessels give way, nothing but evil can follow on such extravasation; it is by all means to be avoided.

The *treatment* is gently antiphlogistic. Blood-letting from the part; general, when the texture affected is internal and important, and especially if tendency to hemorrhage and extravasation be dreaded—as in the lungs; antimonials; saline purgatives; rest; fomentation; position; and the antiphlogistic regimen. Should the action threaten to become chronic, gentle counter-irritation is to be employed. For the results of action, pressure, friction, and other means of gently stimulating absorption, are appropriate, should the natural effort of the part, when relieved from action, not be sufficient. But usually, unless the congestion have been very long sustained, all the serous or fluid part of the effusion is readily taken up by the voluntary act of the absorbents, so soon as the vascular action, which previously held absorption in abeyance, has ceased. During persistence of the congestion, much serous effusion may have taken place into a serous cavity; by suitable antiphlogistics the action has been subdued; and very shortly afterwards the whole of that acute dropsy will probably have disappeared, without any farther remedy having been employed. Thus, for instance, simple hydrocele is got rid of. The original chronic serous collection is removed

by tapping; stimulation is applied to the serous surface by injection; acute effusion of serum follows, and distends the cavity again; but on subsidence of the artificially induced action, this serum quickly disappears; and it is seldom that any reaccumulation even threatens, a healthful balance having been established thenceforth between absorption and exhalation.

Passive Congestion.—This may follow on an imperfect resolution of the active form, as does chronic inflammation on the acute. Or it may be original, unpreceded by excitement. In the active form, the arteries and capillaries of the part are chiefly implicated—dilated, yet carrying on a tolerably vigorous circulation; in the passive, the capillaries and veins are mainly concerned—dilated, but with a circulation much retarded and depressed. The redness is of a dark hue; little or no heat is complained of; a sense of weight and dullness is felt rather than pain; effusion is gradual, and chiefly serous—consequently, with enlargement of texture we have neither tension nor induration; function is more or less disturbed. The characteristic symptoms, as contrasted with those of the acute form, are the dark colour, comparative absence of pain and heat, and soft doughy swelling gradually formed.

The *causes* of passive congestion may be shortly stated to be, 1. previous perverted vascular action; 2. local debility from any cause, more especially as evinced by atony of the blood-vessels; 3. obstruction to venous return; 4. alteration in the quality, and 5. in the distribution of the blood; 6. general debility. (1.) It has been already observed that the passive form may be the consequence of the active; the arteries having recovered their normal calibre and play, while the capillaries and veins remain distended and weak. Or the same may occur in regard to a higher grade of previous action, the truly inflammatory; from whose vascular distention and debility, with sluggishness of circulation, recovery is less likely to prove rapid or complete. (2.) Local debility, however induced—by inflammation, exposure to continued cold, application of poison, mechanical injury—is manifestly favourable to dilatation of extreme vessels, and weakness of circulation there. (3.) Obstruction to venous return is still more plainly and directly a cause of venous accumulation. It may be produced through position: long maintenance of the erect posture tends to induce passive congestion of the lower extremities. Or there may be obstruction by compression; by ligature, tumour, or over-distention of a normal part. Habitual use of a tight garter will occasion passive congestion of the leg; and a similar result will follow on the formation of a tumour in the popliteal space or at the groin, as well as on distention, great and habitual, of the lower bowel by feculent matter. (4.) Diminution of the normal proportion of fibrin in the blood, retards its flow in the extreme circulation, and so favours asthenic congestion—as in simple fever, and in scrofula. (5.) Determination of blood to a part certainly produces congestion there; and if the part have been previously weak, the congestion will probably be of the passive form. Thus an internal organ, having just recovered from either active congestion or true inflammation, with its vital power depressed, and the minute vessels still large and of weak circulation, can scarcely escape passive congestion,

if the patient imprudently expose himself to cold so as to cause decided intropulsion of blood to it from the surface. (6.) General debility, bringing at once proneness to unwonted determinations, with an easy overcoming of the extreme vessels thereby, plainly favours passive congestion. (7.) It not unfrequently happens that two or more of such causes occur in unison, rendering the establishment of the morbid condition all the more certain. Thus the patient described under the fifth head, may be of either scrofulous or scorbutic constitution; and in his case, all the causes will probably have concurred, excepting perhaps direct obstruction of the venous return. And yet that need not be wanting; he may have diseased heart, impeding pulmonic circulation; or organic disease of the liver may seriously retard its venous flow—either circumstance frequently occurring as the more immediate cause of passive congestion, with its troublesome consequences, in the serous cavities.

Results.—1. Resolution may take place, and is to be hoped for; but at best it is a tardy process, and often incomplete. 2. Hemorrhage is not so likely to occur as in the active form; and when it does, it is of an opposite character—still passive; venous, dark coloured, in a quiet slow stream; but this stream, simply by being gentle and furtive yet constant, may lead to serious loss of blood. Its continuance can scarcely be expected to benefit the part, it cannot fail to hurt the system, already weak and perhaps exsanguine; it may usually be arrested therefore with but little ceremony or precaution—a practice very different from what is applicable to a similar event in the active form. 3. Serous effusion is the characteristic result of passive congestion; occurring slowly and gradually, yet accumulating in large quantity by continuance; more aqueous, by containing much less albumen, than the similar effusion of the active form; and most remarkably less amenable to absorption, partly because of the remaining imperfection of venous circulation, partly apparently from the lymphatics also being depressed in function. It may take place into a serous or synovial cavity, constituting a dropsy; or into the parenchyma of a part, forming œdematous swelling. 4. Active congestion often leads on to inflammation; the passive more frequently follows than precedes. And when it does precede, it is only as a predisposing cause, demonstrative of local debility; not only favouring accession of more active disease, but also diminishing the power of resistance and control.

Treatment.—1. Manifestly the first indication of treatment is to remove the cause—whether that be ligature, fæculent accumulation, unfavourable position, or structural change of some internal organ. The last mentioned is, for obvious reasons, often accomplished with difficulty, if at all; fortunately for us, however, it is a cause of passive congestion of much more frequent occurrence in the practice of the physician than in that of the surgeon.

2. An obvious cause having been removed, it is well to disburden somewhat the over-distended vessels, as the second step towards their reduction to a normal state. Punctures are applicable to the ordinary surface when thus affected; scarifications to mucous membrane. The serous effusion is at the same time permitted to escape, and the paren-

chyma thus also relieved. In affection of deeply seated parts, however, we have to rest satisfied with less direct, and probably less efficient means of obtaining this object—a derivant, instead of a directly evacuant effect. The blood is to be coaxed from the part—not so readily as in the active form of congestion—by dry-cupping, sinapisms, or others of the simple counter-irritant class; or blood may be actually drawn, in small quantity, by leeches or cupping, from the part's vicinity; by either procedure—the latter more likely perhaps—derivation is to be expected, so as to relieve, to a certain extent, the gorged and indolent vessels of the congested part.

3. The third indication—after having obtained as much relief, direct and indirect, of the part as we can—is to stimulate the blood-vessels to resumption of their wonted calibre and tone, and the absorbent system to efficient discharge of exalted function; so as both to prevent further serous effusion, and remove that which has already taken place. Friction, at first gentle, and gradually increasing in vigour; pressure, uniformly applied, and also at first used gently—are obvious means of obtaining fulfilment of this indication. They may be happily combined; the one mechanically favouring the retarded venous return, and indeed accelerating the general circulation of the part, the other mechanically promoting the restoration of normal calibre to the blood-vessels; both vitally arousing the dormant energies of the part, as regards both nutrition and absorption—more especially the latter function. Contraction of the vessels may be further favoured by suitable local applications, as zinc, alum, kino, galls, catechu, &c.—especially useful when a mucous surface is the seat of the malady; also by the internal use of general tonics, as the preparations of bark and iron, the iodide of potassium, &c. The latter class of remedies will, of course, constitute a prominent remedy in those cases where marked general debility may seem to have induced the local disorder, and, at all events, tends to its maintenance.

Stimuli are sometimes of use, not in procuring simple retrocession of the morbid action, but by pushing it onwards to a higher grade, whence recession is much more probable. Activity is grafted upon sloth; Passive Congestion is converted into Active. Then, abstracting the stimulus which caused the change, and employing some of the gentle means suitable to the new production, resolution may be hoped for under circumstances much more auspicious. An example of this has been already quoted, as given in the modern cure of simple hydrocele. Other illustrations occur daily, in the stimulating system of treatment so successful in removing passive congestions of the conjunctiva. Care must be taken, however, that our own creation become not worse than the original malady; in other words, seeking Active Congestion only, we must avoid True Inflammation—for this occurring in a part of weakened power, by previously existing disease, is tolerably certain to advance to a result more or less disastrous to texture.

CHAPTER II.

PERVERTED ACTION OF THE NERVOUS SYSTEM.

IRRITATION.

THIS word is here used to denote a morbid condition, different from Inflammation. In the latter we found the blood-vessels of the part to be chiefly concerned in the morbid change, all the component tissues, however, being, sooner or later, more or less involved; here, the nerves occupy a somewhat similar pre-eminence; on perversion of their function, the diseased state mainly depends. The nervous function is excited and perverted, by an irritative agent, applied either directly or indirectly; pain, and other anormal sensations, with more or less disturbance of general function, result. The blood-vessels are secondarily involved, but not in a sthenic form: and such implication does not effect such an alteration of the local circulation, as to lead to effusion and change of structure thereby. The morbid state may be either local or general.

Local Irritation.—Its signs are negative as well as positive. Little or no increase of blood is to be found in the part, little or no effusion, and no change of structure; little unusual heat, and no swelling—unless indeed there be a shade of tumescence by reason of an unwonted fulness of the fibro-cellular tissue; no redness—but sometimes a paleness of the part, from temporary anæmia there—sometimes a livid hue, from temporary passive congestion. Pain is the prominent symptom—sometimes slight, usually intense, occasionally excruciating; unlike that of inflammation, as great at the beginning as at the last; and not only remittent, but intermittent; worse at one time than at another, and during certain periods altogether absent. The general function of the part is disordered; secretion, for instance, may be either increased or diminished in quantity, and variously altered in quality.

As examples of Irritation may be mentioned, disordered function and sensation of the rectum, by the presence of ascarides there—the pain not often great, and usually merged in the sensation of itching; stone in the bladder ultimately leads to various grades of perverted vascular action in the coats, but at first may cause only Irritation—the pain in this case is often severe; simple decay of a tooth often produces aching of an intense description, apparently altogether independent of vascular action. Tic douloureux may be connected, more or less directly, with structural change in the nerve; but in many cases, no such alteration can be detected, and the case is one of pure Irritation—pain is invariably severe, and often agonizing.

The *cause* of Irritation, is the application of an irritating agent directly to the nerves of the part; or to the same nerves, at a distance from the

part affected: or to other nerves, intimately connected by sympathy with those involved in the prominent functional disorder. The irritating agent may be either external to the body, or of its own production; foreign matter of any kind, for example, applied from without; or structural change, the result of the inflammatory process, acting either on the part itself, or on a distant portion of continuous tissue. Thus, a rubbing of the surface produces irritation of the part rubbed; stone in the bladder produces irritation, both directly and indirectly—the latter through reflex action,—in the coats with which it is in contact, and also referred to the mucous membrane of the orifice of the urethra; foreign matter lodged in the kidney acts in the same way; and ascarides of the rectum produce anormal sensation both there and at the other extremity of the mucous canal. Disease of the hip-joint causes irritation at the knee; affection of the liver, at the shoulder; disease of the uterus, in the mamma; structural change in the brain is suspected, not without good reason, of inducing some of the most intractable forms of neuralgia in the face. Again, an irritating agent applied to one part of the body may induce an irritation in another, with which it has no apparent connexion, either by sympathy of function, or by continuity of nervous or other tissue. Foul matter lodged in the *primæ viæ*, for example, may occasion irritation in the face or in the heel; ceasing on effectual discharge of the noxious *fæculent* matter.

Although many examples of irritation are afforded by neuralgia, it is not to be supposed that the terms are strictly synonymous. Neuralgia is of two kinds; a perverted nervous function only, or this dependent on organic change in the nervous structure. It is only the former which constitutes true irritation; structural change may be the cause, the irritative agent, but is not the disease itself.

Inflammation and irritation are in themselves plainly distinct; yet the latter may induce the former—vascular excitement, of a true sthenic type, following on the nervous disorder. In fact, under such circumstances, this irritation may just be considered analogous to the nervous disorder, much more brief in duration, which precedes the ordinary establishment of the inflammatory process. The period of incubation may be said to be peculiarly long. The change having occurred, however, the minor action—irritation—becomes merged in the greater, inflammation; the two are incompatible. Thus stone in the bladder may give first irritation there, and then cystitis; simple tooth-ach may be followed by gumboil; irritation at the orifice of the urethra, from lodgement of foreign matter in the kidney, may be followed by puriform discharge, stimulating ordinary gonorrhœa; ascarides, after much direct irritation, may lead to abscess from inflammation of the bowel.

Treatment.—The indications of treatment are obvious and simple; 1. to remove the cause; and 2. to allay the perverted function of the nerves. Often it is sufficient to fulfil the first. Take away stone from the bladder, ascarides from the rectum, a carious tooth from its socket, and in many cases the irritation will be found to have disappeared very speedily thereafter. If not, then have recourse to the direct application of sedatives and anodynes to the part; and sometimes this

class of remedies may also be exhibited internally with advantage. Heat, it is well known, is powerful to subdue nervous pain. It is to the steam of hot water that Dr. McArtney trusts for allaying nervous disorder preceding vascular action, after wounds or other mechanical injuries. And heat, either dry or moist, is by the voice of every-day experience declared highly available in mitigating the symptoms of irritation of the bowels, as well as of the simply neuralgic form of tooth-ach. Opium, indisputably anodyne, may be used in various ways; it may be gently rubbed on in a liquid form; it may be laid on as a poultice or plaster; or the skin may be exposed by a simple vesicant, and a salt of morphia sprinkled on the raw absorbing surface. Lately it has been proposed to make direct use of the salts of morphia, by inoculation; and the practice has been followed with some success. Hydrocyanic acid may be applied in the form of lotion, or cautiously painted on the part with a hair pencil. Or belladonna, conium, or other selections from the anodynes, may be similarly employed.

Stimuli may be used indirectly, somewhat on the principle of counter-irritation; and sometimes they give relief; a blister on the surface may mitigate a deep-rooted irritation. But they should not be applied directly to the part, otherwise they will very probably rouse the vascular action in a sthenic form, inducing inflammation.

General or Constitutional Irritation.—In this case, perversion of function is not limited to the nerves of the part—more particularly marked in the sensory—but pervades the whole system, and does not appear to be especially connected with the function of sensation. As in local inflammation we found the vascular excitement in the part to be first sthenic, and then more and more to pass into debility and lentor; so in general irritation, it is probable that the first disorder of the nerves is sthenic excitement, sooner or later declining into an asthenic perversion of function. The entire frame suffers in consequence, and the febrile disturbance is of a low type, wholly different from the inflammatory. The average nature of the symptoms may be stated as follows: Strength is more or less impaired; anxiety is expressed by the countenance, and alarm by the words, tone, and gesture of the patient; he is restless—local irritation induces change of posture oft repeated, much more will an irritation which is general; sleep is snatched, disturbed, and unrefreshing; there is great susceptibility of external impressions—especially at first, the sthenic form of excitement being not yet past—the slightest touch, movement, or sound, suffices to startle and alarm; in general the surface is pale, cold, and contracted—occasionally a dry heat and flushing pass transiently over it; the countenance is pale and shrunk—sometimes, like the general surface, temporarily flushed—sometimes stained by a circumscribed spot of red; the pulse is rapid, but neither full nor hard—sometimes giving the sharp nervous jerk, and leaving the vessel, between the beats, as if collapsed and empty—often small, indistinct, and fluttering—occasionally intermittent—indicating impotent alarm of the general circulation, instead of energy and tone as in excitement of the inflammatory type; the tongue is at first loaded, whitish, and moist—ultimately becoming dry, glazed, and preternaturally clean; the stomach

is often, but by no means invariably, disinclined for food, and is apt to reject the little which it receives; general secretion is at first very much impaired, giving arid skin, confined bowels, and scanty urine—afterwards it is much increased, giving profuse sweating, diarrhœa, and copious diuresis—evacuations by no means critical, or resolutory of the disorder, but exhausting by impotent profusion. Frequently, after the morbid condition has existed for some time, Nature seems to rouse herself to an effort towards recovery by reaction, indicated by rigor. This may be followed by heat and sweating of a better kind, tending truly to resolve the disorder; from that time the symptoms begin to abate, and amendment advances satisfactorily, until the just balance of health is absolutely restored. But the salutary effort may fail; and then the downward course becomes more marked and rapid. The functions of organic life become more and more deranged. Respiration, before merely accelerated, becomes embarrassed and quicker in its draught; the pulse is more feeble, rapid and indistinct; the cerebral functions become more and more impaired, as evidenced by delirium, often followed by coma; strength is speedily prostrated; secretion is again arrested, excepting perhaps diarrhœa, which now is truly colliquative; sinking in truth is established, and soon closes in death.

Causes.—The constitutional form may follow on the local; as inflammatory fever seems in most cases to be the consequence of local inflammation. An irritation of the bowels, if considerable, and at all continued, will not fail to induce general disorder, marked by symptoms such as have just been enumerated. Or constitutional irritation may be the remote result of local inflammation. The immediate effect on the system is inflammatory fever; but serious change of structure, with suppuration, having taken place in the inflamed part, the sthenic constitutional disorder passes away, and is merged in one of an asthenic type—Irritation. Hectic, as formerly stated, is one of the forms of this disorder. And thus we see that although irritation and inflammation are morbid states distinct and incompatible, yet the one may pass into the other; in the general as well as in the local form. Local irritation may be the means of inducing local inflammation; general irritation may supervene upon inflammatory fever. And in practice it is highly important to bear in mind the possibility of such transmutation.

Error in practice may effect a more serious change. If, in a case of constitutional irritation, the stimulant system of treatment be adopted prematurely yet actively, the vascular system is probably roused into a sthenic effort; inflammatory fever may ensue, but usually the effort is only partially successful. It seems as if an endeavour were made towards a supremacy of vascular action over nervous; in other words, to induce inflammatory fever. The effort, however, usually falls short of the aim, and *Irritative* instead of *Inflammatory* fever is the result; a condition of the system formerly stated to be of an intermediate character between constitutional inflammation and irritation, and one almost invariably attended with much hazard to the frame.

Treatment.—1. As in the local form, the first and paramount indication is removal of the cause. Its efficient fulfilment is often alone equal

to the cure. Take away the intestinal irritation, and the constitutional disorder quickly follows; remove the hectic cause, and usually the fever speedily subsides.

2. Calm the nervous system. Of the calmatives, it is plain that those are to be preferred—at least in the first instance—which are not likely to over-stimulate the vascular system; for some, as opium, undoubtedly have this effect, while sedative to the nervous; and our object is simply to subdue the ill we have, without endangering the occurrence of another still more serious. Irritative fever under any circumstances is a formidable evil, but, seizing on a system already low and worn, is likely to lead to the most disastrous consequences. Hyoscyanus is justly a favourite remedy. It is not powerful either as an anodyne or as a hypnotic, but “not poppy nor mandragora” soothe so unexceptionably; given in the form either of tincture or of extract; in the latter, sometimes usefully combined with camphor—when inflammatory tendency is not dreaded. One other advantage henbane possesses, in not interfering with the secretions, but rather favouring exhalation from both skin and bowels. Hydrocyanic acid is a powerful and often most satisfactory calmative, more especially in those examples of constitutional irritation following a local irritation of intestinal or gastric mucous membrane. Conium is often useful, and may be given freely, unless palling on the stomach. Aconite and belladonna are also advantageous, in small doses, carefully conducted. In the advanced stage of the disorder, opium is highly beneficial, especially in the form of morphia; now we scarcely dread an over-excitement of the vascular system; on the contrary, an increase of its tone is desirable; and we are glad to avail ourselves of the powerful narcotic influence. The tendency to an arrest of secretion may be obviated by combination.

Sometimes the second indication may be happily conjoined with the first. Thus—again recurring to the example of intestinal irritation—we often remove the irritating agent, while at the same time a calmative is applied both to the part and the system; by the administration of castor oil with laudanum, calomel with opium, blue pill with henbane.

3. Restore secretion. The ordinary diaphoretics, diuretics, and laxatives are available for this purpose. But the indication must be fulfilled gently and with caution. Profusion, with suddenness, might increase debility, tending to aggravation of the disorder.

4. Support the system. As the disease advances, the system gives way; while it is our object to arrest the former, it is not less our duty to enable the latter to bear up under its burden. Disinclination for food is by no means so marked as in inflammatory fever; not unfrequently the appetite is tolerably good; sometimes it is little if at all impaired. It is to be indulged with nutritious and simple food—yet in moderation; given often, and in small quantities; for digestion is weak, and the additional source of farther irritation by lodgement of undigested matter in the primæ viæ is certainly to be avoided. By and bye, food may fail in its sustaining effect on the system, the stomach grows weary, and digestion is weaker than before. More direct tonics are to be had recourse to; and the sedatives are laid aside; for

now the nervous and vascular systems are both in a state of depression. Quinine, calumba, chirayta, &c. are given—yet cautiously; for all risk of the induction of irritative fever has not altogether gone by. Effects are watched, and the tonics increased or diminished accordingly.

5. The disease continuing, both food and tonics become ineffectual. Stimuli are to be administered. Friction and heat to the surface; wine, brandy, ammonia, internally—in small doses, oft repeated. In the use of the alcoholic stimuli, cautious management is most especially necessary. The first effect of a full dose is stimulant, the second just as powerfully sedative; marked depression follows on the marked excitement. It is our wish to produce and maintain the first, and by all means to avoid the second. Minute, or at least moderate doses are therefore given, sufficient to produce excitement—measured not by the wine-glass but by the tea-spoon; the effect of each dose is watched by a competent and assiduous attendant; and so soon as the stimulant effect begins to be departed from, and not before, the dose is repeated. In the same way, as in the local antiphlogistic prophylaxis, we saw it to be expedient to have the first effect of cold continuously maintained, while the second was carefully avoided. And not only is caution requisite to guard against the depressing effect of too large doses, at too long intervals; there is yet danger of over-stimulation; the opposite extreme may be reached; reaction may be induced, in a turbulent, excessive, and unmanageable form; inflammatory fever is not likely, but irritative fever is far from impossible. In the last stage, opium is usually unadvisable. When much sleeplessness, jactitation, or undue efforts towards reaction exist, it may be given; but warily, and even with an unwilling hand; never in large doses, lest narcotism be approached, and sinking thereby accelerated.

Should over-action have been in any way induced, tonics and stimuli are to be desisted from for the time, and sedatives—perhaps with an antimonial—cautiously resumed.

It is very obvious how careful we should be, in not confounding this form of constitutional disorder with that of the sthenic or inflammatory type. Antiphlogistics, more especially if recklessly and freely employed, must tend to confirm the disease, and probably hasten its fatal issue. And the same remark may be generally applied to local irritation also. “Blood-letting aggravates neuralgia, and relieves inflammatory pain; steel and arsenic aggravate inflammatory pain, and cure neuralgia.”*

THE SHOCK OF INJURY.

More or less depression of the nervous system, with a secondary and similar result on the sanguiferous, is usually the immediate result of mechanical injury inflicted on the living frame: proportioned in extent

* Travers.

to the intensity of the external violence, the amount of the portion injured, the relative importance of the injured part in the general animal economy, and the previous state of the system; of an aggravated character, for example, when a part of a limb has been crushed to a jelly by a heavy weight; when a whole limb has been bruised, scalded, or burned; when an internal organ, such as the liver, kidney, bowels, lungs, or brain, has in any considerable degree sustained mechanical injury: when an injury, perhaps in itself not very severe, has been done to a frame either originally weak, or enfeebled by intemperance, previous disease, or either extremity of age. In military practice, bullet wounds of the trunk are often judged of according to the amount of attendant shock; if depression be slight and transient, the probability is that the wound is but superficial, and at all events that the important internal organs have escaped: if it be both great and protracted, the prognosis is on the contrary unfavourable, the inference being that the wound has reached a vital part.

The *symptoms* of nervous shock, after injury, vary from the slightest appreciable lowering of the vital powers, to complete syncope. Ordinarily, the patient falls, and lies helpless, cold, shivering, more or less unconscious, and, when roused, probably incoherent; convulsions may supervene; the pulse is rapid, small, fluttering, indistinct; respiration is imperfect and sighing; nausea and vomiting are common—the latter not unfrequently preceding reaction, and seeming to be concerned in its induction; a cold, dank sweat bedews the shrunk and pale surface; the features are collapsed; the countenance bears a somewhat anxious expression, or else, by entire muscular relaxation, is a vacant, death-like blank; the eyes roll wildly and restlessly, or else are fixed in an upward, listless stare, with the upper eyelid partially closed over the pupil; often the sphincters are relaxed, feces and urine seeming to pass involuntarily; sometimes the secretion from the kidneys is suppressed; the cerebral functions become wholly suspended, the heart's action ceases, and existence terminates.

Sometimes such symptoms abate rapidly, reaction quickly commencing, and soon becoming completely established; sometimes, they persist for hours, reaction proving both late and gradual; not unfrequently reaction fails, sinking is again progressive, the syncope is complete, and life becomes extinct.

Reaction—or a more or less gradual return towards health—is usually preceded by a distinct rigor, and very often by full vomiting. The nervous system is restored, and the sanguiferous is proportionally relieved from depression. Sensation, power of motion, intellectual function, special sense, gradually return. The patient becomes conscious of his state, and inclines to inquire into it; his manner grows less wild and agitated, his eye is steady and intelligent, his countenance less anxious, his features more full and composed; secretion again becomes normal; the heart beats with gradually increasing power and regularity; the pulse becomes more full and equable, and is felt distinctly in the extremities; heat comes back to the surface, and this parts with its pale anserine appearance. The patient recovers himself, in short, sits up,

and once more becomes an intelligent member of the world around him. This may be the result of Nature's effort, alone and unaided ; or our art may assist in its induction.

Whether its commencement be spontaneous or not, its progress should always be watched most carefully. The action may advance favourably to completion, and proceed no further than the attainment to the even balance of health ; little or no extrinsic aid being required, either then or subsequently. Or it may overstep the bounds of health, and pass into disease ; producing either irritative or inflammatory fever, according as the excess is of a sthenic or asthenic character. Or the salutary effort may be imperfect from the first, and asthenic throughout ; partial restoration of pulse, consciousness, and general warmth being quickly followed by relapse ; a febrile accession occurs, but is of the typhoid character, tending to renewed prostration, collapse, and death. Again, in the case of lesion of certain internal organs, as the brain, the premature occurrence of simple reaction may prove calamitous, by escape of blood from the injured part, unfavourable to persistence or resumption of function. And even from an ordinary wound, the progress of reaction must be regarded, otherwise an inconvenient hemorrhage may ensue.

But the shock of an injury may be considered practically as of two kinds—mental and corporeal. In the case of the former, the patient—to use an ordinary phrase—is more frightened than hurt. The wound in reality is but slight, yet the attendant shock is great ; it is, however, transient. Its origin was mental ; alarm, being great and sudden, exercised a most powerfully depressing influence on the brain and general nervous system, which again lowered the circulation, and the combined result may have been a near approach to syncope. But so soon as the mind has been reassured—the injury being both seen and felt to be in truth trivial—the depression passes away, and by reaction the balance of health is soon re-established. The practical importance of distinguishing between this and the more real shock, may be thus illustrated. Suppose a patient about to undergo an operation on account of mechanical injury done to a comparatively unimportant part, and plainly labouring under depression of the general vital powers—shivering, pale, cold, breathing rapidly, of an alarmed expression, and almost pulseless. If this state is but of mental origin, the preparations for operation may be continued ; a few words of kindness and comfort, with perhaps a mouthful of wine and water, will probably suffice to establish almost instant reaction. Whereas, if the cause be altogether unconnected with mental impression, the patient may be removed from the operating table to bed ; for, some considerable time must necessarily elapse, ere the system can have recovered itself so far as to possess a tolerance of operation. The one form of shock is in its nature very transient, the other more or less enduring.

There are many cases in which both forms of shock are more or less combined, as can be readily imagined. For example, a man may be mortally wounded by an unexpected and unseen foe ; the shock of the injury will be great, although entirely corporeal in its origin. A second may receive only a scratch, while he expected nothing but instant death ;

the shock will be serious, and may indeed amount to actual syncope; yet it is purely mental. A third may sustain a serious injury, from an assailant both seen and feared; the shock will probably be intense; mental and corporeal impression both contributing towards the lowering result. In such cases as the last, it is practically useful to ascertain if possible—by inquiry into the history of the accident, and as to the natural temperament of the patient, as well as by carefully noting the existing symptoms—in what proportions the combination has probably occurred.

Treatment.—In the mental form, as already stated, reassurance and a little time are sufficient to recover the patient. In the corporeal, two errors—in their nature very much opposed—require to be guarded against; foolish bleeding, and premature stimulation. A patient having received a fall, is probably found unconscious and incapable of motion; the practitioner would seem, in some instances, to have a peculiar aptitude for mistaking such a state for the coma induced by extravasation; a vision of apoplexy, with its suitable remedy of venesection, passes on the instant through his mind; his lancet, as it were mechanically, leaves its case, and reaches a vein in the bend of the arm, or the jugular vein, or the temporal artery. No blood may follow the incision; and it is well; for loss of blood—a most powerful agent of depression—is not likely to prove beneficial when depression is already great and dangerous. By and bye, reaction begins to be established; the pulse may be felt and counted, the skin becomes warm, and signs of returning consciousness appear; at this stage, bleeding is not unfrequently practised; still it is premature. Nature now, however, is in a better state of self-defence; but little of the precious fluid escapes, ere syncope again occurs, arresting the flow—a protest and a safeguard against the malapraxis. The time for bleeding is neither before reaction nor during its early progress, but after it has been fully established, and when it threatens to advance to an inflammatory excess.

Again, let us suppose that the case is not one of simple concussion, but that lesion of the cerebral structure has occurred. Perhaps the shock—for at first the symptoms may be those of concussion only—is of long continuance; hours may elapse, and yet the circulation is weak, and almost limited to the trunk. This is well; for during such a condition, hemorrhage is not likely to take place from the injured texture; time is afforded for the completion of Nature's temporary hæmostatics; when reaction does occur, and activity of circulation is restored to the brain, bringing with it return of function, no open vessels permit sanguineous extravasation; coma by compression has been happily prevented. This is a beautiful adaptation of circumstances to the attainment of an important and salutary event; let the surgeon look on in passive admiration. But not unfrequently, he is tired of waiting on Nature, and administers stimuli at an early period to bring about reaction; he unfortunately is successful in his short-sighted aim; circulation is restored to the torn part while its vessels are yet open, concussion is converted into compression, and danger to life is increased ten-fold. Under such circumstances—and they are not unfrequent in occurrence—early recourse to stimuli is strongly reprehensible; the

practice must prove in all such cases prejudicial, in not a few it will be certainly fatal.

In the treatment of the shock of injury, then—and more especially when the head is the part injured—early bleeding and immature stimulation are both to be avoided. The injured part receives the mechanical adjustment that is necessary, the patient is laid in bed, or elsewhere, as comfortably as possible; with the head (unless it be the seat of injury) in the first instance rather low, so as to favour return of arterial circulation there. The event is then carefully watched. Reaction may soon occur, without further aid from us, and require even active means for its moderation. When it is tardy, and there seems to exist no reason why its retardation should be desirable, friction and heat are to be applied to the general surface; and should these fail, stimuli are then cautiously administered by the mouth; beginning with simple fluids, such as hot tea or soup, and gradually ascending in the scale, if need be, to brandy and ammonia. The exhibition of these requires care, when insensibility is complete; otherwise they may get into the air passages instead of into the gullet, and suffocate the patient. Also in urgent cases, powerful stimuli—as sinapisms, hot irons, blisters, strong ammonia—may be applied to the surface, with the double object of rousing the spinal system by reflex action, and courting sanguineous circulation towards the part irritated. In the use of such remedies, it is to be remembered that sensation is for the time in abeyance: and unless we—as it were—feel for the patient, the applications are apt to be unnecessarily severe; proving very troublesome, and perhaps even dangerous, in their results, after reaction has been established—as by ulceration, sloughing, or extension of superficial inflammation. The ammonia, for example, of a smelling bottle has often been carelessly thrown into the nostrils, producing sad disturbance there; during the syncope, the patient is unaware of the receipt of this fresh injury; but very soon after reaction, the effects of the over-done remedy may largely predominate over those of the original accident; lives have actually been lost by nasal inflammation, so induced, having extended to the cranial contents.

The internal use of stimuli must also be conducted with extreme caution, and desisted from so soon as circulation is restored satisfactorily; otherwise danger by excessive reaction can scarcely be escaped. If inflammatory fever set in, along with local inflammation in the injured parts, not only are all stimuli scrupulously withheld, but antiphlogistics are administered as circumstances may demand. If, on the other hand, irritative fever be the result, opium or other narcotics, in guarded doses, are to be exhibited. And it is to be borne in mind that when the shock has been severe and protracted—and more especially when it has occurred in a frame previously weak—the sthenic period of reaction is apt to be but short, and the tendency is to gangrene locally, with typhoid seizure of the system; in such cases the more powerful antiphlogistics must be employed sparingly, if at all. When the injury has been attended with great loss of blood, reaction is never of the sthenic form, but of the purely nervous kind, formerly

described when treating of venesection; for the assuaging of this, a full opiate is most effectual.

Vomiting usually disappears before the ordinary restoratives, along with the other symptoms of the shock. Should it prove troublesome—as it sometimes does, with hiccup—it may be directly treated by a sinapism to the epigastric region, and small doses of the *spiritus ammoniæ aromaticus*.

Thus we see the dangers of shock after injury are, 1. Continued depression, sinking, and death; to be met by restoratives, and with abstinence from blood-letting and other sedatives during the early period of the nervous commotion. 2. Inflammation and excessive reaction of a sthenic and vascular character; to be met by blood-letting, and other antiphlogistics; the use of restoratives being of course refrained from. 3. Excessive reaction, probably remote, of a nervous type; to be met by opiates and other calmatives, cautiously administered. 4. Asphyxia, or other disaster, by the use of stimuli and other restoratives; to be avoided by care, prudence, discretion, and coolness on the part of the practitioner.

CHAPTER III.

PERVERTED ACTION OF THE ABSORBENTS.

THAT absorption is effected partly by veins, as well as by the lymphatic vessels, specially adapted for the function, seems now to be generally admitted. This, occurring in excessive proportion as regards the antagonist function of nutrition, produces various effects on the part involved in such departure from health. And it is plain that the abnormal state may depend either on excess of absorption or on deficiency of arterial supply.

When the capillaries of a part deposit an amount of plasma simply sufficient to supply what is dissipated by the current waste, the result is normal; the condition is that of health. When more is exuded than is required to atone for waste, the existing play of the absorbents is unable to prevent accumulation of the excess; the condition is a morbid one, and termed hypertrophy. When, on the contrary, the deposit from the capillaries is insufficient, by deficiency of arterial supply; or when the absorbents exercise their function to an unusual degree, the condition of the blood-vessels remaining unaltered from the state of health—the result is of an opposite kind—still morbid—and called atrophy.

Atrophy.

Atrophy of a part, we have just seen, may occur from excess of waste, or from deficiency of supply. In most cases it is probable that both circumstances concur to establish the result, although the major part is attributable to the latter. The part is gradually diminished in bulk, its structure usually becomes somewhat modified, and its function is more or less deranged.

This state may follow on inflammatory action; as a remote consequence, not as a direct result the connexion is usually with the chronic form. That action ceasing, the absorbents busy themselves to remove the loaded change of structure; and it is not unlikely that this exaltation of their function may be continued beyond what was necessary to restore the healthful balance. Besides, disuse of the part, which attends on chronic inflammation, will necessarily have the effect of diminishing the arterial circulation; and this latter cause of wasting may be further contributed to, by a remaining change of structure in the part itself. Or any of these causes may of themselves be equal to the result. Thus, a testicle, which has been simply inflamed, may become simply atrophied; a limb which has been long disused, on account of inflammatory disease of a joint, or from any other cause, invariably is more or less wasted; granular disease of the kidney is accompanied or followed by decrease in the bulk of that organ.

Treatment. The indications are simple. To allay the action of the absorbents; to strengthen that of the blood-vessels, more especially of the arterial system. The former is attained by gentle counter-irritation—as slight blistering, or inunction of croton oil. The latter, probably the more important of the two, is fulfilled by use of the part, friction, and electro-magnetism if necessary; with resumed function, the nutritious effort is aroused, and normal development usually restored.

Atrophy may not be limited to a part, but affect the whole system; the result of imperfect nutrition—in many ways induced. But this general morbid state comes not within the peculiar province of the surgeon.

Interstitial Absorption.

This may be termed atrophy of a portion of a part, and is most frequently found in the hard tissues; a more direct result of a low form of perverted vascular action, and dependent, chiefly if not wholly, on an exalted and perverted exercise of the absorbent function. The process is most distinct in bone, converting what was dense into cancellated texture; or, by being limited to certain points, interspaces of normal tissue remain, imparting a worm-eaten appearance to the whole. The super-imposed soft textures are usually in a state of passive congestion. The part is slightly swollen, puffy, and darkly discoloured; there is a deeply-seated dull gnawing ache, rather than pain, aggravated by firm pressure. Weakness is complained of in the part; and marked increase of the uneasy sensations follows exercise of it, even when gentle. The

affection is most likely to occur in those of weak frame, and is usually attributed to external injury. In general, dull uneasiness has been felt in the bone, before any affection of the soft parts became recognised. The treatment consists of gentle counter-irritation, rest of the affected part, and attention to the general health.

This morbid state of bone is found to be of much importance, not so much on its own account, as in consequence of its being the precursor and accompaniment of one of the most troublesome diseases with which our art has to contend—caries.

Continuous Absorption.

This differs from the preceding in being continuous, instead of interstitial or interrupted; and, being usually both continuous and progressive, it occasions more or less loss of substance. It may follow, more or less remotely, on perverted vascular action; or it may be accompanied by some such action. But in many cases it seems to be almost wholly unconnected with vascular change, and in all is altogether separate from true inflammation. The loss of substance is a gradual, almost painless, and altogether pus-less process; the work of the absorbents alone. And thus it manifestly differs most widely from true ulceration.

It has its analogue in the opposite condition of repair, or restoration of lost substance. A chasm of the soft parts may be filled up by granulation, or by the “modelling process.” The former is preceded by true inflammation, and is analogous to ulceration. The latter is not only unconnected, but incompatible with true inflammation, and is analogous to continuous and progressive absorption; the one is simple removal, the other simple deposit; both are unattended with inflammation, and both are consequently unaccompanied with the formation of pus. To both the absence of atmospheric contact is essential. Admit this, and inflammation follows—the consequence of sudden and powerful stimulus acting on a part already in an unsound condition. The simple absorption is converted into true ulceration; the modelling process is arrested, ulceration overturns what has been already done towards repair, and then, this destructive action subsiding, restoration commences again in a new way, by granulation.

Familiar examples of this form of absorption are afforded by the gradual disappearance of texture, both hard and soft, before slowly increasing pressure; as by abscess, or by aneurism. And pressure may be considered as by far the most frequent exciting cause. This, according to the amount of its dose, produces different effects. Sudden and great, vitality may be at once destroyed in the part; a less amount, gives ulceration; less, simple inflammation; less, a perverted vascular action short of the truly inflammatory; still less, gradually applied, with exclusion of atmospheric influence, affects the arterial and capillary vessels little if at all, while it excites the absorbent vessels to the morbid result now under consideration.

The treatment consists of abstraction of the cause—usually pressure—rest of the part, and moderate counter-irritation. The two first, and

more especially the first, are the most important, as can be readily understood; and when they have been satisfactorily fulfilled, but little of the last will be required. When the morbid condition has been arrested, the loss which it has occasioned is quickly and simply repaired, by the accession of its analogue the "modelling process;" simple non-inflammatory deposit coming in the place of simple non-inflammatory absorption.

CHAPTER IV.

SUPPURATION.

PUS, it has been already stated, is invariably the product of inflammation; and may be effused either into the parenchyma of a part, or on its free surface. The former condition is termed abscess—of great frequency of occurrence, and of much import to the practical surgeon.

Abscess.

Acute.—When suppuration follows on the inflammatory process, of an acute and sthenic kind, we find the morbid state resolvable into three parts, as formerly stated; capable of being represented by concentric rings. Within the central will be found the pus, extravasated blood, and broken up original tissue. Within the second, is fibrinous effusion, at least partially plastic, and more or less advanced towards organization; limiting, or tending to limit, the suppuration within the central space. The third or external circle represents the diffuse serous infiltration which invariably surrounds, more or less, the central and more important change.

When this state has continued for some time—and more especially when the duration is such as to warrant the appellation of chronic being applied to the abscess—the limiting fibrinous deposit becomes more and more condensed, its central aspect ultimately assuming a membranous appearance and a membranous function; having a smooth villous surface, somewhat like the mucous, and possessing the power of maintaining the formation of pus. Hence it is termed the *Pyogenic membrane*; endowed with very considerable powers of secretion, but as an absorbent surface comparatively feeble. In regard to this latter point, it may be useful to remember that the pus globule, when extravascular and complete, is of comparatively large size, not soluble in its own serum, and therefore but little amenable to ordinary absorption; the serous portion may be taken up readily enough, but the solid probably remains but little affected. And thus the feebleness of absorbent power may depend not so much on deficiency of either structure of

function in the pyrogenic membrane, as on the nature of the fluid on which it has to operate.

Sudden suppression of the purulent formation is to be always regarded as an untoward event. It is more liable to occur in the case of free and open suppuration, than in an unopened abscess. It may be the result of some accidental occurrence, the nature of which it may be difficult at the time to ascertain, or of injudicious stimulation wilfully applied to the part, reinducing the true inflammatory crisis, and for a time at least arresting secretion. It is liable to be followed by irritative fever, usually of a formidable kind, and with difficulty allayed. Or, on the other hand, the local result may follow on the general. A patient labouring under a discharging wound, may become the subject of febrile accession, altogether independent of the previous affection; and during persistence of such fever, the purulent as well as the other secretions will be either arrested or impaired.

Supposing that no accident occurs, the usual course of the abscess is to enlarge, and to approach the surface. The purulent is a waste aplastic fluid, to all intents and purposes a foreign matter, and must be removed. We have just seen that it is little liable to absorption; the only other alternative of removal is by direct evacuation. In most cases this should be the work of the surgeon. But Nature has a mode of her own, and is to a certain extent independent of his interference. The process is as follows: The matter, by continuance of the secretion, gradually and steadily accumulates in larger quantity; and the effect of such accumulation plainly is to make pressure on the surrounding parts. They are thus to a certain extent pushed aside to accommodate the increasing fluid; but the accommodation so obtained is insufficient, and the pressure, not being relieved by adequate extension of texture, occasions more or less absorption of the parts compressed. The fibrinous barrier is not undone, but pushed back; and the surrounding parts are partly condensed by the mechanical result, partly diminished by interstitial absorption, the vital result of the pressure applied. As expansion of the barrier and cyst takes place, these are not attenuated, but, by continuance of fibrinous deposit, are maintained unbroken and efficient; the interstitial absorption is in the textures exterior to them, comparatively uninvolved in the original action. According to mere physical laws, this pressure, effecting an enlargement of the suppurated space, should act equally in all directions; and were the process to occur in dead matter, such would doubtless be the case; but in the living, it is different. The pressure acts more at one point than at the others; and that point on which it is as it were concentrated, is usually, as already stated, towards the external surface. There the dose of pressure is increased; more than the absorbents are implicated in the result, the vascular system is roused, true inflammation is induced, ulceration follows, and by its crumbling agency the parts intervening between the pus and the external surface are gradually removed; at each step the matter becoming more and more superficial. The original fibrinous barrier—and the pyogenic membrane, if it exist—are of course destroyed at the ulcerated point; but it does not thence follow that the pus may at that point overflow its limits, becoming infiltrated into the

surrounding tissues, open and unresisting, thus converting the circumscribed or limited form of abscess into the diffuse. We formerly saw that ulceration is accompanied and surrounded by fibrinous deposit; and this supplements the inroad made on the analogous structure of the original abscess, preventing the deficiency of the barrier which would otherwise occur at the ulcerating part. This process is termed *Pointing*. Its further explanation is difficult; and instead of attempting to assign any explicit reason for its occurrence, it is probably better simply to announce such outward tendency as a well known and admitted law of life. The progress is various; sometimes rapid, sometimes protracted and tedious; depending on the rate of fluid accumulation, and also on the nature of the intervening parts; if these are of a fibrous structure, we know that they will long resist the ulcerative process, and consequently retard the progress of the pent-up matter beneath—almost always injuriously. The ordinary fibro-cellular tissue gives way readily and rapidly, ultimately the skin alone resists; this becomes attenuated, stretched, and completely deprived of its support, for a certain space—usually of no great extent, for the abscess enlarges in a conical form, the apex towards the surface; the stretched and undermined portion sloughs, is quickly detached, and the aperture, thus formed, admits of the pus being discharged.

As the matter becomes superficial, its existence is more and more plainly evidenced by what is termed *Fluctuation*. The fingers are applied over the part, lightly; and either by alternate pressure, or by keeping one still while another is made to tap lightly on an opposite point, an impulse from the fluid is more or less distinctly perceived; the more superficial and copious the matter, the more marked its impulse. When, on the contrary, the pus, yet recent, is but scanty, and the super-imposed texture both thick and dense, the sensation imparted is obscure. Acuteness of touch and experience are both required under such circumstances, to prevent mistake in diagnosis. The surgeon possessed of both, with the additional faculty of using them aright, is said to be endowed with the *tactus eruditus*—a gift of rare value; perhaps partly innate, yet doubtless capable of being acquired by education of both the finger and the judgment. The adipose tissue, when abundant and somewhat tense, has an elasticity which simulates rather closely the fluctuation of abscess. The junior practitioner should by frequent practice early learn to discriminate between the two sensations. And should opportunity offer, let him not neglect to contrast also the elasticity of the medullary tumour, many examples of which imitate accumulation of fluid still more closely.

But the progress of matter is not always to the external or integumental surface; it may be to the mucous. By another law of life—as hard of explanation as the preceding—when the integument is either distant, or separated from the pus by dense fibrous texture, the ulcerative process takes place, not in that direction, but towards a mucous outlet, should that be in the vicinity. Serous membrane, fortunately, has no such attraction. It, being fibrous, resists the ulcerative process, as all such textures do. Thus when matter has formed immediately

exterior to the peritoneum, in the abdominal parietes, it has fibrous texture on either aspect, and the external is the more dense and unyielding. Yet so strong is the natural tendency outwards, when no convenient mucous surface is near, that in almost all such cases the outward progress is steadily maintained through the more dense, thick, and unyielding investment, the peritoneum for at least some considerable time remaining entire, saving the cavity from dangerous purulent irruption. Whereas, when abscess has formed in the deep cellular tissue by the side of the rectum, very often, before it has pointed externally on the hip, it has made its way by an ulcerated aperture into the cavity of the bowel, and thence been discharged. And in the same way, abscess of the lung, or even of the pleura, is more likely to be discharged through the bronchial tubes, than to make its way through the thoracic parietes. How wise is the arrangement whereby the important internal cavities are invested by such a tissue as effectually resists the inroad of advancing matter; while the mucous canals, terminating on the general surface, are calculated to receive and discharge the noxious formation!

Especially important tissues—the arterial, venous, and nervous—may traverse the cavity of the abscess; or, though at first not implicated, may be eventually exposed to the matter's contact by enlargement of the suppurated space. Again, by an effort of Nature, such parts are protected, at least for a time. They are encrusted by a fibrinous deposit, dense and compact, which, as if by itself bearing the brunt of the pressure occasioned by the accumulating fluid, saves the important part which it invests from ulcerative destruction. Only for a time, however, be it well remembered; for should the relieving incision be unwisely withheld, both the protector and the protected are overborne, and the disasters of hemorrhage, false aneurism, or mere destruction of texture certainly ensue.

The *symptoms* which accompany and denote the formation of abscess are sufficiently plain. These are the ordinary signs of inflammation; pain, heat, redness, and swelling. Centrally the swelling is soft and fluctuating; exterior to the soft suppurated centre, is the hard unyielding barrier of fibrin; and exterior to both is the soft, diffused, pitting swelling from serous effusion. As the matter accumulates and points, fluctuation becomes more distinct, the central soft space enlarges as well as becomes more prominent, the surrounding induration recedes, the general swelling assumes a more conical form, and towards the apex of the cone the redness gradually passes into a yellowish tint, the pus showing its own colour through the attenuated integument. Throbbing and increase of pain in general immediately precede the suppuration; and rigor usually marks its occurrence. Should the inflammatory action then subside, as it frequently does—as if exhausted by the effort of having attained to its true crisis—and if the suppurated texture be loose and yielding—the uneasy sensations, though not absent, are continued in an abated form; and on the thin portion of skin blackening and giving way, they are still farther relieved. If on the contrary, as formerly shown, the tissues be dense and unyielding, or the inflam-

matory action be from any cause sustained, the pain, throbbing, heat, and tension are undiminished, or probably rise to an aggravated intensity.

The constitutional symptoms are inflammatory in the first instance; and then these either simply subside, or change into those of hectic, as formerly explained.

Treatment.—The indications to be fulfilled in the management of acute abscess are, 1. To remove remaining inflammation. It has been already stated, that, on the formation of matter, the action which caused it usually subsides spontaneously. If not, a few leeches may be applied in the neighbourhood, and the other antiphlogistics are to be continued. 2. To remove all source of excitement from both system and part. The former part of this indication is met by maintenance of the antiphlogistic regimen; in regard to the latter, foreign matter is to be taken away, muscles relaxed, and the part so placed as not to be ruffled or otherwise irritated from without. 3. To encourage the matter's approach to the surface. For this nothing is so effectual as the constant application of hot poultices, frequently renewed, along with maintenance of strict quietude of the part; and at each renewal of the poultice, hot fomentation may be used for some minutes. The hot and moist applications are of use, antiphlogistically, in more effectually mitigating the vascular action which may remain; besides, by favouring relaxation of the texture, they promote the enlargement of the suppurated space—whereby, as we have seen, approach to the surface is effected; tension and undue pressure are also avoided, which otherwise might occur, re-inducing vascular action all around. 4. To evacuate the matter by an early and free opening. Abridging Nature's effort by artificial means. 5. To subdue the fresh vascular excitement which the infliction of the artificial opening must necessarily induce. Fomentation, poultice, and rest, are still adequate to this. 6. To promote the contraction, filling up, and ultimate closure of the cavity of the abscess.

The three first indications are not to be long persevered in, ere the fourth is arrived at. Three or four days at the utmost—sometimes only as many hours—will suffice for fomentation and poultice; and then, according to the principles of sound surgery, evacuation should be performed. It is no doubt true that Nature is herself equal to overtake this result, unaided; and the mode of her operation we have shown. But the completion of that task, often laborious, should seldom if ever be demanded of her in acute abscess; otherwise harm must accrue. 1. Time is unnecessarily wasted. Nature's mode of evacuation is a gradual and tardy process; the plunge of a knife is the work of an instant; and it may happen, not unfrequently, that time is all-important to the patient. 2. An unnecessary amount of pain is endured. Though after suppuration the painful feelings attendant on the inflammatory process usually subside, yet they do not disappear; not unfrequently pain continues tolerably severe, and is not assuaged until, by evacuation of the matter, pressure, tension, and ulcerative action have been effectually removed. The pain of opening is not slight, but it soon passes away; it is but as a very moderate cost of a most valuable

purchase. If the suppurated texture be fibrous, osseous, or otherwise unyielding, pain is uniformly aggravated instead of being abated by the formation of pus; and therefore the expediency of early evacuation is still more obvious under such circumstances. 3. Texture is greatly endangered. In the ordinary progress of an acute abscess, favourably situated, the majority of the surrounding parts are pushed aside, condensed, and infiltrated by fibrin and serum, while at one point actual destruction of texture take place by the disintegrating process of ulceration. But if the natural effort outwards be balked by resisting texture, as it is almost certain to be in deeply seated abscess, then pressure is increased to a deleterious degree, at other and various points; and those parts which otherwise might have been merely displaced and temporarily altered in structure, now become the prey of an action which is destructive. Cellular tissue is broken up, muscles are separated, periosteum is detached, bone ulcerates or dies, cavities and canals are opened into, blood-vessels may be perforated, joints may be stiffened or destroyed. Such disaster may occur even when the ulcerative process is gradual and of a normal kind, preceded by its fibrinous effusion; but it may happen that the disintegration becomes unusually rapid, and the boundary of fibrin is transgressed; purulent irruption then takes place into the open and defenceless tissue, and both the extent and rapidity of disaster are fearfully increased. 4. The danger is not only local but general. Such destructive results, as have just been alluded to, cannot occur without involving the system in serious disorder. This would be the case, even supposing the parts so injuriously dealt with to be of themselves unimportant; but they may be such as to peril existence almost immediately; hemorrhage may occur from a large artery or vein by ulceration; there may be violent inflammation of an internal serous cavity, or clogging of the air passages, by purulent irruption. It is true that important parts have not only an inherent power of resisting ulceration and other dangers from without, but besides are strengthened by an especial outward defence, as already shown: these will avail to protect, until the abscess have been fairly formed and indicated, giving notice to the surgeon of its formation, and of the time for safe incision having arrived; but if this intimation be neglected, and this opportunity be overlooked, both the intrinsic and adventitious defence will be overcome, and danger and disaster ensue.

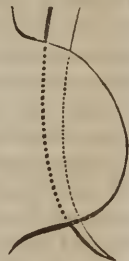
It has long been admitted that open abscesses, inflamed and undergoing ulceration—in fact changed from the condition of abscess, into that of an acute and spreading ulcer—may expose and perforate blood-vessels and other important canals. But the power of unopened abscesses to perform similar ravages would seem to be by many doubted, if not denied, and made an excuse for delay in evacuation. That occult abscesses, however, have such destructive power imparted by circumstances, not only does theory admit as possible, but experience declares as a fact. In deep abscess of the neck, for example, when the pus is bound down by the dense cervical fascia, it is no very uncommon thing, when nature is culpably left to struggle unaided under such adverse circumstances, to find an opening taking place into either the œsophagus or trachea; and recently examples have not been want-

ing of still greater hazard, by perforation of either the carotid or the internal jugular.*

In former times, *maturation* of an abscess was talked of as an event always to be waited for, and made to precede artificial evacuation. It was held as almost a maxim in surgery that ere the knife could with propriety enter the cavity of the abscess, this should have attained to a certain size, not inconsiderable, and have become quite superficial. Such delay may be suitable enough in the case of suppurated cellular tissue, almost or actually subcutaneous; yet time and pain might both be saved even here. And from what has just been stated, it is very obvious that in all cases where the abscess is either deeply seated or in the immediate vicinity of important parts, to practise delay is just to incur neglect and invite disaster. The general rule, therefore, undoubtedly is, to make an early and free opening in acute abscess; time and texture are saved, and pain and peril avoided. And another general rule, arising out of the preceding, is—that in a truly acute abscess, cure by absorption is not to be calculated on in the treatment.

Under certain circumstances, however, we purposely delay evacuation; that is, when our object is to obtain destruction of a part. In obstinate glandular enlargement, for example, which has resisted discussion, we usually endeavour to obtain suppuration—in its own texture if possible, but at all events in its immediate vicinity. Were we to open such an abscess early the glandular tumour might after all escape, and remain as obstinate as before; but in order to ensure its breaking up and disintegration, we delay the opening, that the pressure of the pent-up matter may act destructively. Evidently, this exception corroborates the general rule.

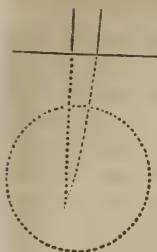
The opening may be effected either by the knife or by the potassa fusa. In the great majority of cases the former is preferred, as less painful, more expeditious, entailing no loss of substance, and less likely to excite and maintain inflammatory action which might extend and aggravate the original mischief. The preferable form of cutting instrument is the bistoury, sharp-pointed, with a fine edge, and either curved or straight. The curved is used when the abscess is superficial and prominent; puncturing the super-imposed textures at their lowest and most dependent point, traversing the cavity of the abscess as far as may be deemed requisite for free evacuation, emerging by a puncture the reverse of that whereby entrance was effected, and then by a rapid withdrawal of the instrument dividing the parts interposed between the points of entrance and exit; thus:—



The straight bistoury, on the other hand, is used when the surface is flat and the abscess deeply seated. The point is held perpendicular to the surface, and steadily advanced through the super-imposed parts, until the cavity of the abscess is reached—as is indicated by absence of resist-

* British and Foreign Review, No. 29, p. 155; and Medico-Chirurgical Transactions, Vol. 25, 1842; also London and Edinburgh Medical Journal, March, 1843, p. 177.

ance, and the freedom of motion which the knife's point may be then made to assume; by a gentle sawing movement, the aperture is made sufficiently wide, ere the instrument is withdrawn. The instrument should be held very loosely, and with readiness to let go on the instant, should the patient by an involuntary start, jerk forward the punctured part; also when the thickness to be cut through is either considerable, or preternaturally dense, sudden plunging of the knife should be guarded against, by employing steady and gradual rather than great and sudden force, and at the same time resting the back of the bistoury on a finger of the left hand laid flat on the integument; otherwise the cavity of the abscess may be completely transfixed, and important parts wounded on the opposite side.



The opening should invariably be made dependent; that is, at the lowest part of the cyst, in order that it may afford a free and efficient drain for the purulent fluid, and thereby not only prevent re-accumulation, but also favour contraction of the original cavity. And in determining the point which is most eligible with this view, we must of course always take into consideration the posture which the patient is to occupy during the cure; what is dependent in the erect posture, may not be so in the recumbent.

Sometimes abscess forms in the immediate vicinity of large and important blood-vessels; as in the neck. And it may be alleged, in excuse for delay, that early incision cannot be made in such circumstances, without much risk to the vessels. It is not so. The abscess is a safe protection from the point of the bistoury, being interposed between this and the vessels—the latter on the further aspect. They may be injured, it is true, by a reckless plunge of the knife, or by an unnecessarily extensive thrust; but such things are not contemplated in the hands of a duly qualified practitioner. Any considerable quantity of matter having formed in immediate contact with the common sheath of the large blood-vessels of the neck, an incision may be made fearlessly down on the ordinary and normal site of these parts, without dread of hazard. In the case of an early incision, the abscess is the protector of the vessels—from the knife's point when opening is delayed, the abscess may become their destroyer, by its own agency.

When the incision has been made through a considerable thickness of parts, there is a chance of the line of wound uniting prematurely; ere yet the cavity of the abscess has been closed, or its interior has ceased from purulent secretion; re-establishment of the abscess necessarily results. To avoid this, such premature union is to be prevented by the lodgement of a foreign body in the track; however simple and slight such foreign matter be, it is sufficient to prevent adhesion. A thin slip of lint is gently inserted with a probe, and retained. All stuffing and cramming of the wound is not only unnecessary, but certain to prove injurious; painful at the time, and certain to excite subsequently a grave amount of inflammation, probably followed by new and more extensive suppuration.

Equally wrong as cramming of the wound, is squeezing of the part after incision. Much unnecessary pain is inflicted, and the existing vascular action is not only maintained but aggravated. If the opening be dependent and free—as it should be—the matter will find its way out readily enough. So soon as the knife is withdrawn, and the more immediate gush of pus removed, a soft warm poultice is applied, and into this the fluid continues gradually to ooze. But should the wound show a tendency to bleed, the poultice should not be applied until the flow of blood has ceased; otherwise hemorrhage, being favoured, might prove troublesome. When the contents of the abscess are of a flaky and semi-solid consistence, as often happens in those of tubercular tendency, the aperture should be especially free, so as to facilitate and insure an effectual discharge.

Poulticing is continued until the vascular action which attended on the suppuration, and which has been somewhat increased by addition of the fresh stimulus of incision, satisfactorily abates; until the textures have been sufficiently relaxed, and purulent discharge fully established; such discharge seeming often to have a resolutive effect on both the vascular action, and the surrounding structural alterations, which it had previously induced. But poulticing may be, and often is, overdone. If continued after resolution of both vascular action and its structural change, harm is done by over-relaxation of texture, maintenance of congestion, and consequent prolongation of redundant discharge. True inflammation is necessary to the first establishment of purulent secretion, but congestion, either active or passive, is equal to its maintenance; and a part, constantly sodden by a hot and moist poultice, cannot be otherwise than congested. There is no doubt that many open abscesses, and many suppurating wounds, are kept from healing, and an exhausting or hectic effect produced on the system, by an undue continuance of poulticing. The first two or three days, after opening, usually suffice for subsidence of the major part of the inflammatory process; and then the poultice is to be superseded by the simple water dressing, applied tepid; not with an antiphlogistic view, but merely protective, soothing, and abstergent. A piece of lint, doubled, steeped in tepid water, and gently squeezed so that water may not flow from it after application, is placed softly over the suppurated part, and covered by a portion of oiled silk of considerably larger dimensions; the object of the latter being to secure the epithem in its place, to retain also its heat and moisture by prevention of evaporation, and to prevent soiling of the bed or body clothes by the probable oozing of fluid. This lint is removed as often as cleanliness and comfort demand; not oftener; "*nimia diligentia*" in such matters is but sorry surgery, as will be afterwards explained.

The progress towards cure is usually as follows. After opening, inflammation is produced in and around the abscess, by two exciting causes; the injury inflicted by the knife; and the stimulus, not inconsiderable, caused by the sudden contact of atmospheric air with the interior of the abscess—a part previously altogether unaccustomed to such influence. This fresh vascular excitement, we have already seen,

is usually subdued in a few days, by rest, fomentation, and poultice; but not before important change has been thereby effected. It induces ulceration in the exposed surface of the abscess; disintegrating the pyogenic membrane, when that exists. But the action being transient, so is the ulceration; effusion of fibrin continues, and, by subsidence of inflammation, becomes at least partially plastic: a portion, perhaps the greater, still degenerates into pus; but the remainder adheres to the surrounding original texture, becomes organized, assuming the structure of cellular tissue and capillaries, and the form of fleshy eminences which are termed granulations; and these occupy the place of the pyogenic membrane, or of the fibrinous deposit which was being transformed thereto—for, in recent acute abscesses, time may not have been afforded for completion of the membranous change. In other words, a suppurating surface with destructive action, is exchanged for what is granulating and reparatory. Granulations are merely organized and vascularized fibrin peculiarly arranged—in the form of small, conical eminences; pointed, red, vascular, and sensitive; bleeding, when even slightly touched; and the blood is of a florid arterial hue. They not only occupy the place, but assume also the function of the pyogenic membrane to a certain extent. For pus is essential to their normal state. They require protection from atmospheric influence, and other source of injury from without; the power of secreting thick healthy pus in moderate quantity is given to them for this purpose, that they may coat themselves with an adherent yet ever-changing covering, until finally and more effectually protected by cuticular formation, on the completion of cicatrization.

By the organization of fibrin to a greater or less extent, in the form of granulations, new matter is obtained for the filling up of the chasm; but it is not by this process alone that closure is effected. The surrounding primitive textures, which had been condensed and displaced during the abscess's formation and enlargement, being now relieved, by a vital resiliency seek their former condition. Formerly they receded; now they practise a directly reverse movement, centripetal. And thus by a simultaneous occurrence of this expansion of the original tissues, with the formation of new matter to repair the loss by ulceration, the cavity of the abscess partly contracts, partly is filled up; and the granulating and suppurating surface becomes superficial. Cicatrization, by the formation of new skin to permanently invest the raw surface—the last part of the process of cure—is then effected, as will be afterwards related, when treating of the healing of wounds.

During the process of cure, water dressing is applied, tepid; should the character of the granulations indicate debility, the application is to be medicated, variously, according to circumstances, as will also be afterwards explained. Re-accessions of inflammatory action may take place; these are to be carefully guarded against, and, when they occur, combated by the usual means. When the site of abscess is deep, care must also be taken that the superficial portion do not close prematurely—by the occasional interposition of a slip of lint, or other dressing—that the contraction may proceed uniformly, from the bottom upwards.

Should the part become pale and flabby, with secretion of thin pus, and tendency of this to accumulate and remain in the cavity, general support of the part, and moderate pressure over the cyst, by bandaging, are advisable. At the same time the system should be looked to; and it will probably be found to require support likewise.

In certain cases the caustic is preferred to the knife. In small chronic abscess, in which opening has been delayed, the integuments are attenuated to a considerable extent at the most superficial point. On discharge of the matter, they have not power sufficient to effect cohesion with the subjacent parts, and perish sooner or later either by ulceration, or by sloughing. The use of caustic under such circumstances not only opens the abscess, but, by at once destroying the feeble and thinned integument, expedites the healing process, and renders the cicatrix both more sure and stable. Or, in addition to such a state of matters, obstinate glandular enlargement may exist, the abscess having formed in the cellular tissue around it. Were evacuation to be performed by incision, this gland would continue to project centrally from the wound, and thereby delay, or perhaps altogether prevent cicatrization; besides, it is an object to get rid of such morbid structure, even supposing it were not an obstacle to healing. Let the caustic which effects the integumental opening, be thrust into the gland in one or more places, and the result is a suppuration which disintegrates the whole. Also, if the patient decidedly object to the knife's use, from timidity or prejudice, and unwisely shun one pain to incur a greater, caustic may be employed. The best form is the *potassa fusa*, pressed firmly on the part, till the abscess is entered—moved laterally also, if need be, to destroy integument—or pushed deeply, to break up glandular enlargement. A little oil is then applied, to neutralize the redundant alkali, and so save the surrounding parts; and the whole is covered with a poultice.

Chronic Abscess.—The formation of chronic abscess is a comparatively slow process in all respects; most liable to occur in those of feeble constitution; and the product either of chronic inflammatory action, or of action which is sub-acute and transient. The attendant symptoms—redness, pain, swelling, tension, heat—are comparatively trifling; some of them may be altogether absent; and the progress, whether superficially or in any other direction, is tardy. Indeed it is probable that in the truly chronic abscess, enlargement of the suppurated space never occurs by ulceration, but is effected merely by condensation, and by interstitial and continuous absorption of the surrounding parts; unless, indeed, acute accession supervene. There is little or no surrounding effusion of fibrin, farther than what is necessary to constitute the pyogenic membrane; and by this circumstance, the distention of that membrane, with condensation of the surrounding parts, is manifestly favoured. The pyogenic membrane, being more leisurely formed, is more fully developed, more highly organized, and probably possessed of both absorbent and secreting power to a higher degree than in the acute abscess. The pus is thin, the serous portion predominating largely over the globules; and this circumstance, conjoined with the greater efficiency of the lining membrane, renders the contents

of a chronic abscess comparatively much more amenable to absorption. We have no hope of curing an acute abscess without evacuation; in the chronic, discussion is not unlikely to prove successful.

Sometimes the liquor puris is absorbed, while the solid particles remain in a compact and condensed form. Such an occurrence, for example, is by no means uncommon in the testicle.

It may be imagined that the disappearance of abscess by absorption of its contents, though a desirable result as regards the part, may be fraught with danger to the system, from admixture of noxious fluid in the circulation. But it is to be remembered that the process is a very gradual one, and that the fluid is chiefly of a serous character; and farther, that absorption previously to an external opening having been made, is much safer than when atmospheric contact has been permitted—an apparent effect of this being to deteriorate the purulent fluid. Sudden suppression of discharge, and sudden absorption of pus from an open wound, are both likely to be followed by serious constitutional disorder; but by the gradual absorption whereby disappearance of an unopened chronic abscess is effected, the system is usually little if at all disturbed.

Chronic abscesses are found to vary from the smallest size, to cavities capable of holding two or more pints of fluid. When deeply seated, the very indolence of their nature insures their attainment to huge dimensions, should their progress be unopposed by treatment. In all cases approach to the surface is slow; for the accumulation of pus being very gradual, pressure is not likely to increase so as to occasion ulceration; besides, as already stated, there is comparatively little surrounding fibrinous effusion to hem in the secretion as it does accumulate—a circumstance which renders the occurrence of tension and pressure all the more improbable. Hence it is one characteristic of the collection to enlarge almost equally in all directions, without the tendency to point as in acute abscess.

Treatment.—When the abscess is *small*; stationary, or nearly so; or of itself showing signs of recession by absorption; and more especially if so situated as to render the avoidance of deformity by cicatrix extremely desirable—discussion is by all means to be attempted. The general system is to be put in good order, particularly as regards the general secretions; the patient is to be denied much liquid of any kind, and enjoined to live sparingly on dry food; and exhalation may be at the same time increased—for the blood must be more or less serous in character, and the frame may be compelled, as it were, to maintain this essential condition by absorption of its own secreted fluids. The iodide of potassium is to be cautiously administered internally, beginning with small doses; and a direct stimulant to absorption is to be applied to the part. This last indication may be variously fulfilled. The Emplastrum gummosum, or the E. Hydrargyri, may be applied; or a plaster composed of equal parts of each; or the surface may be lightly and repeatedly blistered. But on the whole, the preparations of iodine are preferable to all others; either in the form of ointment, or in that of simple solution. My own experience is adverse to the former; more especially when combined with friction, as it usually is; over-

stimulation is apt to be induced, the vascular system is roused as well as the absorbent, and chronic action is converted into acute under very unfavourable circumstances. It is better to pencil the part frequently with either the ordinary tincture of iodine, or with the following solution; Iodine, a scruple; iodide of potassium, two scruples; water, an ounce—increased or abated in strength according to circumstances. Even with this application caution and watchfulness are necessary; and should signs of over-excitement appear, it must of course be at once desisted from, and not resumed until the chronic state has been again established. Usually the skin becomes brown, cracks, emits serum, and is somewhat painful; but such uneasiness, when merely integumental, is not to arrest the use of the remedy; for usually while such is the state of the surface, the soft tumour beneath is found to be satisfactorily diminishing. Often thick crusts of cuticle form during the use of this application, becoming only partially detached; they should be removed from time to time, so as to expose the recent formation beneath to the more effectual operation of the remedy. A sea voyage, more especially when somewhat protracted and rough, has been often found effectual in discussing small chronic abscesses; as in the neck, or groin. Probably in consequence of the profuse and continued exhalation from the general mucous surface, along with abstinence from almost all ingesta, which such uncomfortable circumstances usually produce, favouring absorption in a remarkable degree.

When a small chronic abscess is not stationary, but steadily enlarging; and more especially when it is situated in an important neighbourhood—it should receive the same treatment as if it were acute. That is, free, early, and dependent incision; leaving the part to granulate and cicatrize.

Chronic abscess when *large*, may be treated in two ways. 1. It may be dealt with as if acute. But in this there is some danger. The large pyogenic surface is certain to inflame, under the double stimulus of wound and sudden admission of atmospheric influence; and this inflammation is apt to be of a violent and intractable nature—entailing acute ulceration; discharge of much unhealthy matter, usually more or less mixed with blood; and perhaps infiltration of this into the tissues around, through breach of the pyogenic barrier. Constitutional irritation, of a grave kind, will necessarily follow on such local mischief. Hence, after incision, the treatment should for some days be very soothing, watchful, and guarded, as regards both part and system; that such disaster may be if possible avoided, or at all events limited to a moderate and tractable form. After the period of such danger has passed, the ordinary treatment of a granulating wound is to be employed; bearing in mind that constitutional support will be sooner required, than in the after-management of acute abscess.

But when the chronic abscess is large, and the state of system such as to indicate intolerance, along with susceptibility of inflammatory action—as is often the case—the other mode of treatment should certainly be attempted.

2. Our object is, by a sub-cutaneous and valvular form of evacuating incision, to prevent atmospheric contact with the interior of the cyst.

Inflammation of the cyst, and parts adjacent, is what we dread ; and the cause of this, as already stated, is the double stimulus of incision and unwonted atmospheric influence ; the latter being probably the more potent of the two. If the latter cause be abstracted, the former may be neutralized by rest and soothing treatment ; the inflammatory disaster is averted. An incision, merely through the skin, is made about an inch and a half or two inches from the point at which we intend to penetrate the cyst. Into this wound a finely pointed long trocar and canula are inserted, and pushed gently along beneath the skin ; and, having reached the point of puncture, an elevation of the handle plunges the instrument through the pyogenic membrane. Assured of the canula's extremity being fairly lodged in the cavity of the abscess, we cautiously withdraw the trocar. The canula, where it projects from the wound—about an inch and a half from its external orifice—is furnished with an accurate stop-cock ; and so soon as the point of the retreating trocar has cleared this—as is indicated by a mark made on the shaft of the trocar, with this view—the stop-cock is turned, and the trocar wholly withdrawn. A small exhausting syringe, neatly fitting the canula, is then applied ; the stop-cock is turned open, and by the play of the syringe the purulent contents are slowly and gently evacuated. This having been effected, the syringe is removed, the stop-cock having been again shut ; and the canula is cautiously withdrawn,—the fore-finger of the left hand following closely on its retreating point, so as to shut up the wound, and effectually prevent the admission of air. The wound's orifice is then covered with Liston's simple and tenacious plaster ; and the track is likely to close by the first intention. It has been proposed, in order to make the procedure more certain, to perform such manipulations under water ; but due attention to all the steps of the operation, as just described, will surely render all other precaution against the air's admission quite unnecessary.

While the contents of the abscess are being gradually withdrawn, moderate and uniform compression should be applied to the part from without, to afford a compensatory support for that which is removed from within ; and after healing up of the wound, this external support should be for some time continued. The precaution is as necessary as in tapping for ascites. If it be neglected, hemorrhage, by giving way of venous or capillary coats, is not unlikely to occur ; the admixture of blood leads to deterioration of the discharge, acts as a foreign body, and kindles the adverse inflammatory action, which we are so anxious to avoid. By such pressure, also, the centripetal contraction of the surrounding parts, along with shrinking of the pyogenic membrane by interstitial absorption, is favoured ; and accumulation is thus vitally, as well as mechanically opposed. When reaccumulation has occurred, we do not wait for any approach to the former dimensions, but at an early period repeat the valvular tapping, at a different point, or at the same—should that seem preferable. One or two repetitions may be required, ere the disease is overcome. But, on the other hand, after even a single performance, the cavity may have wholly contracted, and absorption removed the remaining component parts of the abscess—

solid as well as fluid; or the abscess may have so far diminished in size, as to render recourse to the ordinary treatment by direct incision both safe and effectual as a means of completing the cure.

The Abernethian mode of treating chronic abscess—at one time much in vogue—consisted in making a small direct puncture into the cavity, only partially withdrawing the contents, sealing up the wound with a view to adhesion, and repeating this operation frequently, so as very gradually to effect contraction of the cavity. Sometimes it proved successful, more frequently it failed; in all cases it was tedious and troublesome. Air was admitted, the wound often failed to heal, frequent repetition was essential. It is now almost generally abandoned, as inferior to one or other of the modes here described.

Should the valvular mode fail; that is to say, should inflammation supervene, in consequence of accidental admission of air, or from any other cause, an instant transition must be made to the other mode of procedure. A free and direct incision must be made into the abscess, so as to at once evacuate all the contents; the subsequent action will probably be severe, and perilous to the system; yet it is to be unhesitatingly encountered, as the less of two evils. For were closure of the oblique wound maintained under such circumstances, the constitution would be certain to suffer to a much greater extent, even supposing the local action to be less severe. There is great deterioration of the discharge; a bad kind of purulent fluid is effused from the inflamed surface; the general contents undergo chemical as well as vital change, in consequence of the presence of atmospheric air; and if such fluid be kept pent-up within the cavity, absorption of noxious matter, both in the gaseous and in the fluid form, is inevitable, inducing a grave amount of irritative fever, probably tending towards a typhoid result.

Sometimes—indeed not unfrequently—the cavity of the abscess contracts only to a certain extent; and then becomes stationary, or begins to extend in an opposite direction. This may happen in the acute form, but is much more likely to occur in the chronic. The opening which was originally dependent, and sufficient for effectually draining the whole space, may in consequence become insufficient; a new aperture—or *counter-opening*, as it is termed—consequently becomes necessary; it is made in the same way as the original opening, its site being chosen so as, along with the original, to command a complete drainage of the cavity in every part. It may happen that when the abscess has been large, undulating in its outline originally, or prone to subsequent extensions, two or more such counter-openings may be necessary. But, in the great majority of cases, if the original opening have been well placed, and the rest of the treatment judiciously conducted, not even one additional incision need be made.

Sometimes the cavity fails to contract obliteratively, notwithstanding that the opening is in every way suitable. It may be that the pyogenic membrane is yet entire, secreting pus, and forming no granulations. Or granulation may be simply defective, and the centripetal movement of original textures exhausted. Under such circumstances, we desire to excite inflammation; in the one case, it will disintegrate the pyogenic membrane, by an ulcerative action; in both, it will bring fibrin to the

part, which, on subsidence of the action from the inflammatory acmé, will become more or less plastic, be converted into the form of granulations, and hasten reparative completion. If there be but one opening, stimulating injections, varied in strength according to circumstances, will fulfil the indication; aided by continued pressure. If there be two openings, a few threads of silk may be passed through, and retained in the track for a few days, after the manner of a seton, until the required amount of action has been obtained.

Sinus.—When the cavity of an open abscess has by contraction dwindled down into a mere canal—that is, a space in which longitude far preponderates over breadth—lined by a perfectly formed and well-acting pyogenic membrane, the condition is termed a sinus. Not unfrequently, fibrinous deposit continues exterior to the secreting membrane, rendering the parietes of the canal thick and of almost cartilaginous hardness. The discharge is thin, containing few of the pus globules, and resembling rather a depraved mucous than a truly purulent secretion. Left to itself, this state of matters might continue for a very long period. The obstacles to healing are the existence of the adventitious lining membrane, and the action being simply secerning instead of reparative.

The first thing to be done, is to ascertain the extent and form of the sinus; and whether it be single, or connected with one or more collateral branches. For this purpose the ordinary silver probe is used; blunt pointed, and pliable; and passed with all gentleness, yet with a curious care—so as to avoid perforation of previously sound texture, at the same time obtaining an accurate cognizance of the extent and form of the sinus. But, generally speaking, the former error is the more to be guarded against, as being both the more serious and more likely to occur. The probe has not unfrequently been passed forcibly beneath sound fascia, or through intermuscular cellular tissue previously unbroken; and on the withdrawal of the probe, the knife has followed in the artificial track, making a cruel wound where no wound was required.

Treatment of Sinus.—We are first to inquire whether there be a cause whereby complete closure of the abscess has been prevented, and the reparative action been lowered to the merely secerning. Such will not unfrequently be found; consisting of foreign matter lodged in the part, either introduced from without—and then probably the cause of the original abscess, as well as of this subsequent degeneration; or a decayed portion of the frame itself—as dead portions of bone, tendon, or fascia; or formed by perversion of a normal secretion—as salivary, urinary, and intestinal concretions, escaped from their original site. If the lodgement of such matters have induced the original inflammatory disturbance, it is not unlikely that they may escape along with the first contents of the abscess, when this is freely opened, whether artificially or by nature; for this is the mode which she adopts for their extrusion; matter is formed around them, and with this they are floated out, as it were, through the evacuating aperture. But the extrusion may either altogether fail, or be but imperfectly performed; and any foreign body, remaining impacted in the part, will not fail to prevent the entire contraction of the open abscess, and establish the condition of sinus.

When such palpable cause then can be found, accounting for the origin and continuance of this morbid state, it is in the first instance to be removed. In effecting this, by the probe, forceps, or scoop, some little injury is necessarily inflicted on the parietes of the canal; they bleed, are painful, and inflame; and the action may be such as to disintegrate the lining membrane, and bring sufficiency of fibrin for active granulation. After extraction of the foreign matter, therefore, it is well to wait for a little; for this act may of itself prove sufficient to establish a cure. If not, stimulating injection may afford the aid required, in the way formerly mentioned.

Still failing, pressure is had recourse to; not carelessly applied, but with a little management, suited to the ends to be obtained. In the first place, we presume that the extent and form of the sinus, or sinuses, have been accurately ascertained. Over the track is applied a well-fitting firm compress, and retained by bandaging, so as to make direct and tolerably severe pressure on the whole of the secreting surface—severe because intended to induce inflammation, which in its turn is to effect ulcerative disintegration of the pyogenic membrane. The desired inflammatory result having been obtained, the pressure is discontinued, until inflammation and ulceration subside, and granulation commences. Then it is reapplied and continued, but with much less intensity, the object being merely to afford support to the granulating surface, and prevent accumulative retention of the purulent fluid.

Should pressure fail—as it may do, the part being so dull as not sufficiently to obey the inflammation-seeking stimulus—then a more severe remedy awaits us; incision. Again supposing the probe to have been carefully and skilfully employed, it is followed by a probe-pointed bistoury, whereby the sinus is to be laid open throughout its whole extent; usually it is superficial, and consequently not in the near neighbourhood of important parts; hence such wounds, even when extensive, are seldom attended with troublesome hemorrhage or any other hazard. Should blood-vessels, or other important textures come in the way, they are of course to be avoided. The incision will certainly be followed by inflammation throughout its whole extent; for to ensure this, and prevent adhesion at any point, a slip of lint is placed in the track, and retained until suppuration is established. By the inflammation, the secreting surface is certainly broken up and undone; the structure of granulation is certainly raised on its ruins; the part has been converted into the condition of an ordinary granulating wound, and we have only to tend this process, ensuring that it advances steadily and uniformly from the bottom, by avoiding premature closure of the surface.

Throughout the whole of such local management of abscess, and its results, it is most essential that the state of the system be duly regarded. During progress and persistence of the inflammatory process, the anti-phlogistic regimen is enjoined, and a selection probably made of some of the weaker antiphlogistic remedies—as antimony, and moderate purging. When the simply suppurative stage has been fairly established, all lowering agents are to be dispensed with, and by and bye support given to the system, that it may bear up under the spoliative discharge, and the tendency to hectic which that necessarily induces;

such support consisting of food and drink, gradually increased in generosity, and followed if need be by tonics and stimuli.

Treatment of Hectic.—Hectic fever, the nature and symptoms of which were formerly considered, may be connected or not with suppuration; most frequently it does occur in connexion with the exhausting discharge, or with the structural change in important parenchyma, which suppuration usually occasions. Whatever the cause, it is very plain that this, if apparent and capable of being removed, should in the first instance be taken away, or at all events that means should be adopted towards the attaining to this end. Thus if the febrile disorder attend on a copious discharge of pus from a large surface, as after direct incision of an extensive abscess, our object will be to moderate this discharge, and, by favouring granulation to the best of our ability, expedite contraction usually occasions. This will be effected by local support and other management of the part, as already mentioned; along with support of the system by food and tonics, that it may in the meanwhile endure the spoliation until the salutary local change be completed. This is a slow removal of the cause, yet not the less an effectual one.

Were it in our power to obtain a sudden drying up of a purulent discharge to which the system has been long accustomed, we should not avail ourselves of that power; knowing that such an event would be almost certainly followed by irritative fever of a formidable character.

If the hectic cause be a hopeless change of structure in a limb, connected or not with suppuration, it is removed by a more summary process—amputation; for it is better that a part of the body be destroyed, than the existence of the whole be perilled. The shock of such an operation, on a frame already worn and weak, is no doubt considerable. Yet it is surprising to observe how well it is usually borne; and when the shock has passed, amendment is commonly found most marked and satisfactory; the pulse may have fallen twenty or thirty beats; all the febrile symptoms have abated, and may not return. For some time after the operation, undertaken for relief of an urgent hectic, often life is felt to be quivering in a balance, lightly poised; the cause for anxiety is great; yet the treatment should be but expectant. The judicious surgeon is well contented to remain a passive though anxious spectator: he knows that the affair is much too delicate for the interference of his comparatively clumsy hand, and wisely does little more than await the far more dexterous working of Nature. The inexperienced and unskilful, on the contrary, is likely to deem it his duty to be then and at all times busy; he plies sedatives, restoratives, tonics, stimulants; the balance is probably quickly turned—but not in favour of the patient.

What may be termed the general treatment of hectic is conducted according to the principles formerly explained, as applicable to constitutional irritation—of which, hectic is but a form. The powers of the system are succoured by food and tonics; mild opiates are given to procure sleep, and calm restlessness and other nervous excitement; mineral acids, to check the profuse and impotent perspirations; astringents, to check the tendency to diarrhœa; and lastly, stimulants, should sinking threaten to ensue. Never forgetting, in regard to the last mentioned class of remedies, that all depends on their mode of exhibition;

if in large doses, with long intervals between, the fatal issue is likely to be accelerated; it is from small doses only, oft repeated, and each carefully watched in its effects, that a fortunate event can be expected.

Diffuse Abscess.—An abscess is said to be diffuse, when the suppuration is not surrounded and limited by plastic fibrinous effusion; and when consequently the pus—in such circumstances of a thin, apparently unhealthy, and probably acrid nature—is so soon as formed readily infiltrated into the surrounding texture, open and unprotected; with a result most disastrous to the part, and oppressive to the system. Cellular tissue is broken up, disintegrated, killed; integument is undermined, and subsequently sloughs likewise; the suppurated space is rapidly and greatly extended—for the infiltration of a bad pus acts as a fresh exciting cause of an inflammation, similar to that from which itself sprung, and so the process of infiltration, suppuration, and destruction, may be prolonged almost ad infinitum. This is bad enough, supposing the action to be limited to the surface; but, although usually commencing there, it is apt to extend in depth as well as superficially; and the deeply-seated result is all the more serious, in proportion to the greater importance of the parts implicated in the mischief. The attendant constitutional symptoms are those of irritative fever.

Treatment.—The local indications are—1. To arrest the inflammatory process, if possible, ere it has reached the suppurative crisis. This is difficult; for the action is asthenic, and the progress is rapid essentially; else the surrounding and limiting circle of fibrin would not be deficient. The attempt is to be made, when circumstances permit, by the ordinary antiphlogistics, early and actively employed. 2. When matter has formed—and it usually does form, in spite of our efforts to the contrary; and, more frequently still, it has formed before our attention is called to the part—our object is to evacuate what is already secreted, to limit action and thereby prevent further secretion, to save the surrounding parts from infiltration, and to grant an opportunity of escape to that portion of texture which may have already perished. All this can be accomplished by one proceeding, and by that only—incision. A bistoury is passed freely into the infiltrated part, throughout its whole extent; establishing one or more wounds, according as the extent and form of the infiltration may demand. The fluid already formed readily escapes, and along with it a considerable quantity of blood; by this bleeding the vessels concerned in the morbid action are directly rifled of their contents, and the probability is, that the inflammation will in consequence subside; and the subsequent formation of pus in the part originally affected, as well as continuous extension of the action to neighbouring parts, will be either diminished or altogether arrested. After bleeding has ceased, a light poultice, or the water-dressing, is applied. Suppuration for a time is tolerably profuse; for ulceration is necessarily in progress, in order to detach the cellular tissue which had perished, ere the incision came to its relief. In no long time, the slough is separated, and comes or is brought away; granulation is begun, the discharge becomes less copious and more laudable, the wound fills up, and cicatrization is duly completed.

It is very plain that incision, in this disease, should be practised at a

very early period; so soon as we are satisfied that infiltration is begun; the longer the delay, the greater the danger to texture; and the greater the destruction to texture the more serious the disorder of the system. Further, it comes to be a question whether incision should not be had recourse to at a still earlier period, ere matter has formed at all; this being the most likely means of arresting the advancing action, and so preventing suppuration altogether, except at the mere line of wound. In most cases of superficial disease of this nature, we have no difficulty in answering the question in the affirmative, as will be more fully stated when treating of phlegmonous erysipelas.

After incision, the local treatment is as for an ordinary suppurating wound; applying early, gentle, and uniform support by bandaging, to prevent farther infiltration by accumulated discharge, to favour cohesion of the partially undermined parts, now freed from their foreign fluid, and to accelerate the general process of granulation.

The *irritative fever* is best treated by effectual and early removal of its cause; that is by the local management just detailed. Often little else is required. During the first, or partially sthenic, period of the symptoms, antimony, belladonna, or aconite may be given cautiously; softening the pulse, and allaying those symptoms of the febrile disorder which border on the inflammatory type. Afterwards, the period of debility having arrived, the same manner of treatment is required as for hectic, or constitutional irritation in general—into which form of disease the case has then in truth resolved itself.

SCROFULA OR STRUMA.

By this term is generally understood a state of system prone to the formation of purulent matter, and to the deposit of a peculiar substance, termed *tubercle*; hence the synonyme of Tuberculosis. Usually the tubercular deposit precedes the suppuration; this occurring in the tuberculated part. The abscess is most frequently of the chronic kind, but liable to acute or sub-acute accessions; the matter is thin and flaky, often mingled with more or less of the broken up tubercle. The favourite site of the deposit is in the lymphatic glands, and in the superficial cellular tissue, sub-mucous as well as sub-cutaneous; but bones, joints, internal organs, and indeed every texture is liable to be affected.

This cachectic state is either hereditary or acquired. Usually it may be traced descending from parent to child, from generation to generation; all the more likely, and all the more inveterate, if there be inter-marriage of those nearly related by blood. But, on the other hand, a child may be born, itself in all respects healthy, and of healthy descent, both immediate and ancestral, and yet in the course of years come to show all the signs of the confirmed strumous diathesis. The circumstances likely to induce the unhappy change are those of a peculiarly debilitating tendency; exposure to atmospheric vicissitude, by insufficient clothing and shelter; improper and scanty food; lingering and wasting disease; imprudent use of mercury, especially in tender years;

excessive labour, mental or corporeal; and habitual deprivation of healthful air and exercise. Or again, such events may not be the means of inducing this disorder in a frame previously healthy; but only the direct and exciting causes of it, in a system already predisposed by hereditary taint. The disease is not communicable by contagion or inoculation, as has been proved by direct experiment; and it is found to prevail more in temperate climates, as this, than in either the extremely hot or cold—variability seeming to be especially favourable to its accession. It is also more frequent in towns than in the country, as are all other diseases of debility. Females are said to be more liable than males; and the especial period of accession, even in those whom the tendency is congenital, is between the ages of three and seven years; but indeed the whole period of adolescence is favourable to its occurrence, the normal balance of health being then more easily deranged by accidental circumstances than at a more mature age. In those of confirmed scrofulous habit, the tendency to development of diseased action varies also according to season. Spring is the period of exacerbation; more especially the month of March. This month is supposed to represent the maximum of the crisis; January and June its extremes of accession and decay.

The disease is evinced by outward signs, usually very distinct, and these are generally divided into two varieties, according to temperament; the sanguine and phlegmatic. In the former the complexion is fair, often beautiful, as well as the features, and the form though delicate often graceful. The skin is thin, of delicate texture; and subcutaneous blue veins are numerous, shining very distinctly through the otherwise pearly white integument. The pupils are unusually spacious, and the eyeballs are not only large but prominent, the sclerotic showing a lustrous whiteness. The eyelashes are long and graceful, unless ophthalmia tarsi exist, as not unfrequently is the case; then the eyelashes are wanting, and their place occupied by the swollen, red, unseemly margin of the lid. In the phlegmatic variety, the complexion is dark, the features disagreeable, the countenance and aspect altogether forbidding, the joints large, the general frame stunted in growth, or otherwise deformed from its fair proportions. The skin is thick and sallow, the eyes dull, though usually both large and prominent; the general expression is heavy and listless, yet not unfrequently the intellectual powers are remarkably acute, as well as capable of much and sustained exertion. The upper lip is usually tumid, so are the columna and alæ of the nose, and the general character of the face is flabby; the belly inclines to protuberance; and the extremities of the fingers are flatly clubbed, instead of presenting the ordinary tapering form.

Tubercle, the peculiar product of this depraved state of system, presents the following characters. When first deposited, it is a clear viscid albuminous substance, becoming more and more solid by coagulation as does fibrin; but differing materially from it, in being less highly vitalized, and incapable of true organization. When more or less solidified it loses its transparency, becoming gray, yellow, or drab-coloured; and this is termed its crude condition; usually it is friable and of caseous

consistence; often invested by a thin pellicle, which ultimately may assume the character of an adventitious membrane or cyst. It may remain in this state for a long period; consisting of granules, and of particles apparently identical with the exudation corpuscle, but containing no truly nucleated cell; receiving additions by apposition, not by intussusceptive or intro-cellular development; incapable of vascularization, consequently containing neither blood nor blood-vessels; also, incapable of being converted into any resemblance of the original tissues. But usually it begins to soften after no long time, probably in consequence of a chronic inflammatory process having been established in the parts in which it is imbedded; it changes colour, becoming lighter; and having reached a cheesy consistence, crumbles down, and is mingled with a thin purulent fluid poured out from the surrounding parts.

Tubercle may be variously deposited; in small, isolated points, termed miliary; in granular masses, distinct or confluent; infiltrated diffusely into parenchyma; or aggregated in a mass, and enveloped by a cyst composed of condensed surrounding tissue, constituting tumour.

The formation of this peculiar aplastic substance would seem to depend on want of power in the system to maintain the process of assimilation in a perfect state; the aplastic albumen is not sufficiently converted into the plastic fibrin. "The albuminous materials prepared by the digestive process are not converted into the fibrinous matter which is ready for assimilation; so that, by a perversion of the ordinary nutrient actions, albuminous tubercle is deposited in the interstices of the tissues, instead of these tissues being themselves regenerated by organizable fibrin."* By many it is supposed that inflammation is essential to the production of tubercle; but such is not the case. The formation of this substance is merely a perversion of nutrition; and inflammation is no more necessary for the unhealthy than for the healthy development of this process. Tubercular matter often accumulates in a part, without any unusual vascular excitement, either precedent or accompanying. But, on the other hand, the inflammatory process, occurring in one of a strumous habit, may be accompanied by rapid and extensive deposit of tubercle instead of the ordinary plastic exudation—albuminous tubercle, instead of organizable fibrin.

Such being the condition of system which leads to the formation of tubercle, we can readily understand how certain general symptoms are common to both varieties of scrofula. Digestion is weak and imperfect, and this is indicated as usual by abnormal states of the tongue and bowels; the muscles are soft, flabby, and weak; the blood is thin and watery; the general circulation denotes debility, and is liable to oft-recurring derangement within itself; the extremities are cold; and in short there are a greater or less number of the usual indications of want of tone, and general debility.

The ordinary progress of scrofulous disease is as follows:—Suppose that the tubercular deposit has taken place superficially; in a lymphatic gland, or in the common sub-cutaneous cellular tissue. If accompanied

* Carpenter.

by perverted vascular action, there will be the ordinary obscure signs of the chronic inflammatory process. Perhaps, more frequently, it is neither preceded nor attended by excitement; the enlargement and induration, by accumulating deposit, are gradual and painless; and probably first observed, simply in consequence of increasing bulk. But vascular excitement, sooner or later, is established, in and around the part, as evinced by dusky redness, slight pain and heat, and increase of the swelling. The swelling, as it enlarges, softens; fluctuation is perceived; the skin becomes thin and undermined, the matter not coming rapidly to a conical point, as in the sthenic acute abscess, but as in the chronic form approaching the surface scarcely more rapidly than it is enlarging in every other direction. If an artificial opening be not made, the skin sloughs; thin serous pus is discharged, containing flakes of aplastic albumen or fibrin, and mingled with broken down portions of the true tubercle. Infiltrated cellular tissue is exposed, soft and apparently about to slough; and from this a profuse secretion of the watery pus is maintained, containing more or less of the softened tubercle, as well as of disintegrated or sloughed original tissue. The surface remains discoloured and swollen; and the skin around the margins of the wound is thin, blue, undermined, and inverted on the suppurating surface beneath; and usually the aperture enlarges, by sloughing or ulceration of the skin so affected. The surface of the sore, of a yellow or pale red hue, after a time produces granulations, tall, few, pale, flabby, lowly organized and vascularized, possessed of but little sensibility, and not effectual towards cicatrization; closure advances tediously and imperfectly; is long of being completed; and when completed is unstable and unsatisfactory; the cicatrix blue, soft, and liable on the least re-accession of vascular excitement to be undone by ulceration—the ulcerous part has been covered over by a film, but not truly healed. Cellular tissue, or any other superficial tissue, infiltrated by tubercular matter, is incapable of granulation whereby a permanent and satisfactory cicatrix—white, firm, and depressed—can be obtained; to effect this, the infiltrated part must be removed, by the act either of the surgeon or of Nature—by caustic, or by spontaneous sloughing; on a firm foundation alone can the true reparative structure be raised.

Even when an apparently satisfactory cicatrix has been obtained, the cure is not to be regarded as complete; for if the constitutional vice remain unremoved, as too frequently is the case, disease is likely to return in the original site, as well as elsewhere. In treatment, therefore, our attention must be directed fully more to the system than to the part; and also, the constitutional care must be maintained long after healing of the local disorder.

Treatment.—This is local and constitutional; the latter the more important, as already stated. In most diseases, and especially in this, prevention will be found better than cure. When a child therefore is born of parents of the strumous diathesis, all those circumstances, formerly noticed, likely to induce development of the disease, a tendency towards which is congenital in the patient, should be most carefully avoided. And, in accordance with the view taken of the cause of the depraved tendency or state of system, it is plain that the line of

treatment, whether preventive or curative, should be tonic. The best tonic treatment consists, not in medicine, but in due regard to food, bowels, skin, air, exercise, and climate. The food should be in sufficient quantity, generous and nutritive, yet simple, and not in such quantity as to exceed the power of digestion. The bowels should be kept in a regular and normal state, by attention to diet and exercise; assisted if need be by simple laxatives; purgatives being avoided, unless in urgent circumstances, and more especially mercurials. For mercury is justly held incompatible with the scrofulous diathesis, more especially when used so as to produce its constitutional effect; and purgatives are dangerous, because likely to induce tubercular deposit in the mucous membrane of the intestinal canal, or to cause softening and suppuration of deposit which may have already occurred there. The skin is kept warm, by sufficient clothing—flannel not omitted; and clean and perspirable by daily bathing, as well as ablution; the bath should be cold, and sea-water is to be preferred when season and other circumstances are favourable. Reaction is the object of the cold bath; and when this fails either altogether or in part, the bathing should be abandoned; perseverance would occasion more harm than benefit, exerting a depressing and relaxing influence instead of a tonic. Within doors, the patient should be at all times in an atmosphere which is dry, pure, and often changed by ventilation; and exercise in the open air should be daily practised, short of actual fatigue. If possible, a climate should be made choice of, which is dry, bracing yet temperate, and free from sudden yet habitual vicissitude. Should the disease threaten, notwithstanding, this regimen is to be assisted by selections from the class of simple tonic medicines—bark, cascarilla, calumba, rhubarb, &c. Alkalics also are usually found of much service; not only as neutralizing acid to which the patient is especially liable, but also seeming to exert a beneficial influence on the blood. But there are certain remedies which aspire to the rank of specifics in this disease—and the foremost of these are the preparations of iodine, more especially the iodide of potassium. This medicine is given in solution, in doses of from gr. i. to gr. iii. thrice daily; watching the effect, so as to avoid the somewhat violent physiological result which continuance of full doses is apt to induce. The beneficial operation would sometimes seem to be increased by combination with cantharides. Iron likewise is much in favour, not only as an excellent tonic, but also, like the alkalis, as having a beneficial influence on the blood; probably directly augmenting the red corpuscles—as well as the proportion of fibrin, indirectly through its general tonic effect. The muriates of lime and barytes once held a high reputation, but latterly have fallen into sad, and it is to be feared, not undeserved neglect. Walnut leaves in the form of extract have been lately brought prominently forward, but their reputation has yet to be made. The cod liver oil is the most recent of the list; and its claims have been ingeniously enough strengthened by theory. Benefit is of course to be expected from the proportion of iodine it contains. But besides—in scrofula, it is said that “the nitrogenized elements of nutrition are in excess; the evacuations even become albuminous, and are glairy like white of egg; gradually the albu-

minous principle of the blood becomes predominant, while the globules are diminished in quantity; at the same time the fatty or carbonized principle disappears, and emaciation takes place; at length albumen is deposited in the textures, constituting tubercular effusions—the whole of this process is evidently one of perverted nutrition; and that this is owing to an absence of the carbonized or oleaginous elements, and an excess of the nitrogenized or albuminous, must be evident. The indication of cure then, under such circumstances, must be to introduce into the system the first named principle, namely, fluid fat, or oil, in order that it may combine with the excess of albumen, and constitute a healthy blastema for the support of nutrition.”* One cannot help suspecting, however, that fat might be given in a more palatable form, and iodine be exhibited in a more elegant vehicle. A happier combination is iodine with iron; the iodide of iron; best given in the form of solution; a table-spoonful may be taken twice daily of a mixture containing a scruple of the Pharmacopœial Sol. iod. ferri, in eight ounces of water; and this may be either combined, or alternated, with the decoction of sarsaparilla—a medicine also of some note in the treatment of the strumous cachexy.

The local treatment varies according to the stage of advancement. While the deposit is yet recent, and the enlargement chronic and indolent, it is usually our object to effect discussion. The preparations of iodine are used both externally and internally, with this view, as in the case of the chronic abscess. The form of ointment, applied by friction, is less objectionable here; inasmuch as there is less risk of over-stimulation being thereby induced. Discussion having failed, then suppuration is to be sought for rather than dreaded; and if possible made to occur within the tuberculated part, in order that full disintegration and removal of the morbid product may ensue. But in scrofulous patients, small abscesses not unfrequently form, unconnected with tubercular deposit. These are amenable to the ordinary rules of treatment, formerly detailed; and when they are situated in a part habitually exposed as the face or neck, a small opening should be very early made, so as to limit suppuration, favour contraction, and avoid the deformity of a large, irregular, and depressed cicatrix. Usually, however, the suppuration is secondary to the deposit; the abscess is of a chronic nature even from the first, and approaches the surface slowly, with a broad front, enlarging almost equally in all directions. If still anxious to avoid an unseemly mark, an early and minute opening may be made; but the result is likely to be only partially successful. It is better practice to delay the evacuation until the skin has been thinned, and an opportunity afforded for disintegration of the tubercle being at all events efficiently commenced if not perfected. The potass is then used as the opening agent, destroying attenuated skin so far as may seem necessary, and if need be at the same time making a destructive thrust into the tuberculated part. The matter is evacuated, and the diseased texture sooner or later brought away; granulation is in due time commenced, and the ordinary means are then adopted to favour its progress

* Bennett.

and completion. Constitutional treatment is maintained, uninterrupted; and, as already stated, it must be long persevered with after apparent local cure; for in the general system is the true seat of the disorder. It is almost unnecessary to state that chronic enlargements of lymphatic glands, by tubercular deposit, as in the neck, are not to be made the subject of surgical operation. Discussed they may be; or by suppuration they may be broken down and extruded; but extirpation is in truth but a bloody, reckless, and unwarrantable cruelty; injurious to patient, surgeon, and surgery. Such operations have been performed; but it is to be hoped that never again will they be repeated.

CHAPTER V.

ULCERATION.

THE theory and nature of ulceration have already been considered. We have seen that it may follow on wound, or occur in a part previously entire; that it is the product of true inflammation; that it effects loss of substance, not by absorption, but by vital softening and disintegration; that on the subsidence of inflammatory action, that of ulceration usually soon follows in its wake; that ulceration is succeeded by granulation, and that by this healing is obtained. The healing process now falls to be described.

Granulation.—The first and essential step towards this, is subsidence of the perverted vascular action from the true inflammatory acmè. Suppuration continues, but with this difference; that whereas previously all the effused liquor sanguinis degenerated into pus, and was extruded, its fibrin being rendered altogether aplastic by the co-existence of true inflammation, now only a part so degenerates and passes off; a plastic portion remaining incorporated with and superadded to the original secreting tissue, in the form of granulations—red, fleshy, vascular, conical eminences. These in their turn assume the secretive action, to produce a certain amount of laudable pus for their own protection—as well as the nutrient action, in exhalation, for the production of fresh granulations similar to themselves; and thus the chasm is in part filled up, and continuity of texture restored. Only the recently formed granulations, however, retain that character; what were granulations, but are now covered by a fresh formation, change altogether; the layer becomes condensed, more highly organized and vascularized; is in truth incorporated with the original texture from which it sprung; and were a section now made of the whole part, it would be hard to tell the recent from the original formation. And this circumstance has led some to suppose that only one layer of granulations is ever formed, and

that consequently closure of the chasm is in all cases and altogether effected by contraction of the original texture. That much of the closing movement is thus produced, there can be no doubt. On the occurrence of a solution of continuity, whether immediately by wound, or more gradually by ulceration, a vital elasticity inherent in the parts occasions their resilience to a considerable extent; and gaping from this cause is increased by the occurrence of inflammation. When inflammation has subsided, however, and granulations begun, tendency to part asunder ceases, and the textures begin to move in a precisely opposite direction; contracting centripetally, as in the closure of abscess—from what exact cause, vital, physical, or both, it boots not at present to inquire. This resumption of place by the old tissues, going hand in hand with the production of new substances, gradually fills up the gap. The granulations come to the level of the adjacent integumental surface; but covered only with their own transient and fluid secretion; their permanent investment has still to be effected, by cuticular formation; that is the last part of the process of cure, and is termed *Cicatrization*.

Cicatrization is in truth the process whereby the granulations, when on a level with the surrounding original skin, are permanently covered by a new integumental substance, resembling cuticle rather than true skin. Its commencement is observed at the periphery of the granulated space, where a thin whitish pellicle is seen put forth from the original skin—which skin is unusually vascularized, on purpose to sustain the exaltation of the secretive function—and very slowly over-spreads the raw surface; thinnest and most transparent at the margin, where of recent formation; thick and opaque where in contact and continuous with the parent tissue from which it has sprung. On the commencement of this process, the space to be invested is being gradually diminished, however, not merely by advance of the investing formation, but by actual diminution of the space itself; and this is caused by gradual condensation and decrease of the newly-formed substance, from interstitial absorption. It was by the deposit and organization of this that continuity of texture was restored; and it is very plain that, this restored continuity remaining unbroken, a diminution in the bulk of the connecting medium cannot fail to bring the original parts into near and more near apposition. But it is not to be supposed that this absorption of what was granulation continues until all has been removed, and that consequently the breach becomes permanently closed without the presence of new matter, merely by contraction of the old. This may happen in some simple wounds which heal by granulation, when there has been no loss of substance, and when the original tissues are lax and capable of easy replacement; for certainly an original texture is an infinitely more efficient structure than any recent imitation, however successfully organized; and as such will doubtless be preferred by Nature in the work of reparation. But in all ulcerations there is loss of substance; and in most ulcers there is condensation of the surrounding tissues by fibrinous deposit; circumstances which render new formation, to a greater or less extent, quite essential not only to the temporary but also to the permanent closure of the gap.

The new formed integument, when completed, is termed the *cicatrix*; at first redder than the surrounding parts, thin, and tender; but gradually becoming pale, more dense, less acutely sensitive, and diminishing in extent by the process of absorption beneath, as just explained; ultimately thick and firm, not more sensible than the surrounding parts, and paler in its hue—for its permanent organization and vascularization are less perfect. In truth the new texture differs from the old in structure as well as in appearance; the true cutis is too complicated a texture to be easily reproduced in a perfect form; as has been well remarked by Mr. Travers, the new formation is only a copy, and like all copies inferior to the original.

It has been stated that the new cuticular formation commences at the free margin of the old skin, and is thence gradually extended. Such is the general rule. No points of new skin spring up from the granulations, and enlarging gradually coalesce with the advancing marginal development. In many indolent superficial ulcers, especially when these are the result of burns, there is a semblance of this, but only a semblance; where the central islands of skin appear, the old integument had not been wholly destroyed; and it is from the remains of original cutis vera that such insular pellicles have been formed, not from granulations altogether recent. Yet it is easy to imagine how such new matter should have the power of producing for itself a cuticular covering. The exudation corpuscles which come from granulations on a level with the original surface need not all degenerate into pus, neither need all those saved advance into high organization to form additional granulation; a portion of the former, the latter, or of both, may advance to the condition of nucleated cell only; some remaining in contact with the granulating surface, and receiving moisture therefrom, form the lower layer of the epidermis; others, flattening, drying, and becoming non-nucleated, may constitute the superficial epidermic scales. It is thus, or somewhat thus, doubtless, that epidermis is formed from true skin, after abrasion; and why it may not also be in the same way formed from any other organized soft texture, it is hard to imagine. Yet we know the fact to be, that such formation seldom occurs—so seldom, as merely to constitute the exception to the general rule, that integument is formed by and from integument. It is well to bear in mind, however, that such exceptions may and do occur. For instance, when there has been much loss of substance, undoubtedly involving the entire thickness of the cutis to a considerable extent, as after burn, part of the formation of new skin may be effected in the usual way; then the process may remain stationary for a long period, as if the old skin had become wholly exhausted in the formative effort; and after long delay, a cuticular film may be seen arising from granulations, at one or more points, spreading to meet that which had come so far from the circumference—as if Nature, foiled in her ordinary mode, had reluctantly found herself constrained to adopt another held in reserve for emergencies only.

It is not intended to be understood that the original skin sustains both the production of the organizable material, and the management of the organizing process; the major part of the blastema, whence the

cuticular formation is produced, is doubtless furnished by the parts immediately beneath—granulations—and these may also contribute much to the organization; but the process of organization is commenced by the original skin, in that portion of the blastema with which it is in immediate contact; and the continuance of the process is then doubtless maintained by those parts, whether recent or old, with which the advancing pellicle comes in contact. All deviations from such arrangement, are but deviations from the general rule. And a close analogy will be found to obtain in repair of the hard textures; new osseous formation originates with the parent bone, and is then continued apparently by periosteum, as well as by other soft textures which may have assumed the place and function of that membrane where deficient.

The healing process, resulting from combination of cicatrization with granulation, may be obstructed by various circumstances. True inflammation, its most formidable foe, is fatal to it. The fibrin becomes once more aplastic; and the process of granulation is arrested. But besides, all new structures being especially prone to ulceration, this follows on the inflammatory re-accession; and in consequence, not only is granulation hindered, but undone; what has been already raised in repair, is probably disintegrated, and crumbles away. And the process of repair will not again be restored, until the true inflammation, and with it ulceration, has satisfactorily subsided. On the other hand, an obstacle may arise from deficient, instead of excessive, vascular action; there is a want of fibrin, the secretion being merely of thin fluid, rather mucous or serous than purulent; out of this granulations cannot be constructed, and the chasm remains unclosed. But this part of the subject will be better elucidated, when treating in detail of the various kinds of ulcer.

Ulcers.

These are breaches of continuity effected by ulceration; and may occur in any texture, though in some more readily than in others. At present, we have only to do with those which affect the surface; seated in the skin, or in the cellular tissue beneath, seldom implicating the deeper parts. They are every day occurrences in the practice of surgery; and as such are apt to be regarded lightly, by the student, and perhaps even by the junior practitioner. But all such persons should be made early to know how egregiously they err in such an estimate, of what in truth constitute one of the most important classes of disease with which the surgeon has to do. The very frequency of their occurrence renders it eminently necessary that our art should be well prepared with an efficient remedy; the more especially when it is remembered, that these accidents are most likely to befall those whose limbs are of most value. The rich man, even when otherwise unhealthy, is comparatively exempt from ulcer of the limbs. The poor and labouring man is too often ill-fed, ill-clothed, hard-worked; all day in the erect posture, often wet and weary, and liable to external injury in the exercise of his calling; and it is in such members of the community that by far the greater number of ulcers are found, and usually of a formidable kind. Should the disease threaten in the rich, he lays

himself up forthwith, the suitable remedies are employed—of which perhaps rest and position are the most important—and in a few days probably the part is cicatrized. But the poor man cannot afford to do so; his limb is ulcerated; as yet, however, it is not very painful, and he works on; it gets worse, but the erect posture is still practicable, and it is maintained; and often it is only after the sore has both inflamed and sloughed, rendering motion and the erect posture at length impossible, that the sturdy-hearted peasant abandons his labour, and applies to the hospital or to the surgery for relief. In proportion to the reluctance of his application, is his anxiety for restoration; his children depend upon his exertions for food; and if the period of cure prove protracted, pinching poverty will too surely be their lot. Thus a heavy responsibility may be almost daily thrown on the practising surgeon; which he must be fully prepared to meet, else his portion cannot well be one of either happiness or contentment. But as the right understanding of a disease is, at least in one sense, half its cure, we proceed to the consideration of this subject in detail.

There is no more serious error than that of exclusively treating disease by name, and in the abstract; instead of inquiring carefully into the nature of each individual sample, and bringing forward remedies appropriate to each sign or symptom, as they may occur. And there is every reason to believe, that such careless generalization in practice is found to affect the treatment of no disease more frequently than that of ulcers. One lotion, one ointment, or one plaster or poultice, comes to be regarded as quite a panacea, and is used in all cases indiscriminately—whether for benefit or hurt, being a mere matter of chance, with probability bearing much towards the latter. To avoid such injurious haphazard in treatment, it is essential that we understand thoroughly the nature of all the varieties of sore; and towards this end there is nothing so useful as a right classification; each variety showing its distinguishing characters, and bearing at the same time its appropriate treatment. Not that we mean to designate each as a separate disease, but only as a separate variety of the same disease—ulcer; entreating the student to remember, that in the treatment of such affections much care and watchfulness are required; inasmuch as they have a great tendency to pass from one form into another, and that by no very gradual and protracted transition; and that consequently an application which is altogether suitable one day, may on the next become very inappropriate.

Classification.—The following will be found to include the great majority of ulcers. Under one or other of the varieties every example may be arranged; or if the exact type be not there, it will be found somewhere intermediate, and easily deducible therefrom. 1. The Simple Purulent, or Healthy Sore. 2. The Weak. 3. The Scrofulous. 4. The Indolent. 5. The Irritable. 6. The Inflamed. 7. The Sloughing. 8. The Phagedænic. 9. The Sloughing Phagedæna.

1. *The Simple Purulent, or Healthy Sore.*—This is in truth an example of healthy granulation, supervening on wound, or on inflammatory disintegration of a part previously unbroken in its surface. The discharge is thick, creamy, easily detached from the granulations, almost inodorous, not too profuse; in fact it is laudable pus. The granulations

are numerous, small, acuminate, florid, sensitive, vascular; if touched at all rudely, they bleed and are pained; the blood is arterial, neither profuse nor normal in quality; and the pain is but the just appreciation of injury done to a healthy part, not the extreme and persistent nervous impression of morbid irritation. The general sensation in the part, when not injured, is slight tenderness, or a feeling of rawness, rather than actual pain; not unfrequently a sensation of itching is present, to an extent even troublesome. The granulations when brought to a level with the surrounding skin—partly by subsidence of this from the state of inflammatory engorgement, partly by their own elevation—remain at that level; and the process of cicatrization is forthwith begun. At this stage, the integument surrounding the granulating surface has a slight tumescence, and is a little more red than in ordinary health, being more vascular; and its free margin is fringed by the growing pellicle of the advancing cicatrix, considerably paler than the original skin. If the granulations are long uncovered, except by pus, whether on account of the large extent of granulating surface, or any other circumstance tending to protract cicatrization, the almost inevitable result is a degeneration in the character of the ulcer; which comes more or less to resemble the second class, whose characteristic is debility. This circumstance is very much affected by situation; the neare to the centre of circulation, the more rapid is cicatrization, and the less the tendency to degenerate. A sore on the leg is slower to heal and more apt to become weak, than one in other respects similar, but situate on the arm; an ulcer of the trunk is more favourably disposed than either.

Treatment.—This is simple as is the nature of the sore. The part is placed and retained in a state of repose; and in such a position as at once to relax the muscles implicated and favour venous return. Simple tepid water-dressing is applied, the pledget of lint not larger than is sufficient to invest the raw surface; not hot, for the object is not to relax; nor cold, otherwise it might prove stimulant instead of grateful to the tender granulations; its object is simply protective, assisting the purulent secretion, until the cuticular formation is complete. When symptoms of debility ensue, it must cease to be simple, and become stimulant by medication.

When the granulating space has been diminished to a mere spot, adventitious protective aid is often well superseded by an effort of Nature; the secretion coagulates, and forms a dense, blackish, impervious, callous crust, under which the healing process steadily advances. It may happen, however, that discharge is redundant; and if such be the case, while the crust is on all sides adherent, the circumstances are unfavourable; the part has in truth been converted into a superficial abscess; and the confined matter, by pressure on the tender and recent surface, reinduces ulceration there; the part becomes hot, painful, red, and swoln, the crust is elevated and tense, and on its separation a deep ulcerating cavity is exposed. The possibility of such an occurrence therefore is always to be borne in mind, and the part examined from day to day; a slight touch of the crust will suffice to tell whether matter be accumulating beneath or not; if it be, the crust must be gently removed, and water-dressing resumed; if there be no accumulation,

Nature's protection is left undisturbed, it ultimately separates of itself, and on its decadence a completed cicatrix is disclosed. The natural crust may be artificially imitated, if it be itself slow to form; by passing nitrate of silver lightly over the part, so as to coagulate the secretion; and then leaving this to harden and dry; or superadding, to become incorporated with the crust as it hardens, a small and fine portion of lint or charpie. Or, the water-dressing—simple, or medicated, according to circumstances—may be continued until the end of the cure.

Then comes the question, not unimportant, how often is such dressing to be renewed; the oiled-silk raised, the lint taken away, the redundant discharge gently removed, a fresh portion of lint laid on, and the oiled-silk re-adjusted; with a slight retentive bandaging if necessary? The answer to such question is—as seldom as possible; just as frequently as cleanliness demands, and no oftener. When the discharge is seen soaking through the dressing, and beginning to drain away, renewal is had recourse to; for not only are the circumstances filthy, and as such affecting injuriously not only the patient but those around; but besides, the discharge, becoming subject to chemical change, grows irritant, and may induce degeneration of an inflammatory type. There is then a necessity for change; but until such necessity occur, let no change be made; inasmuch as it cannot be effected, however delicately and dexterously, without some injury being done to the tender surface by the admission of atmospheric influence, as well as by rude mechanical contact; and by the oft repetition of this, again—from a cause directly opposite to the preceding—inflammatory degeneration may be induced. The “*nimia diligentia*” of surgery is fraught with manifold injury; and is an error against which the junior practitioner should especially guard. In practical surgery, nothing, however simple in itself it may appear, should be done without a good and substantial reason.

Another error, at least equally pernicious with too frequent dressing, is an affected nicety in making the change of application; not only wiping away the redundancy of discharge, but insisting on a perfectly clean abstergeance of the surface of the sore itself, till it look pretty and red; washing, sponging, rubbing, irrigating; thwarting Nature in one of her most beneficial acts; taking away, clumsily and rudely, the best protection of the tender surface; invoking inflammatory action, or tendency thereto, with consequent degeneration of the sore. At each dressing, wipe gently away the pus from the surrounding integument, but do not interfere with that which covers and protects the granulations; your dressing is subsidiary to this, and ought not to supersede it. The means whereby the cleansing is effected are also a matter of some moment. Usually, it is by a sponge; but this is likely to prove injurious, especially in the wards of an hospital. A sponge is a thing of some value, in the eyes of a patient or nurse, and not to be lightly parted with. It is used not for one patient only, but for many, or all. It becomes soaked with discharge, of various kinds; it is hastily and imperfectly cleansed after each employment, and ere its course is run can hardly fail to have been the means of conveying noxious matter to previously healthy sores, inducing their degeneration, and perhaps exciting the serious complication of erysipelas. Instead of sponge

therefore, especially in hospital practice, let fine tow, lint, or soft linen rag, be used as the abstergent agent; a thing of no value, and which consequently may be burnt as soon as used, and have no opportunity of carrying contamination. And, generally speaking, the basin of cold water, usually in attendance during the dressing, may be well dispensed with; dry and gentle wiping of the surrounding skin, leaving the actual sore untouched, is all that is required; more is not only unnecessary, but tolerably certain to prove injurious; it belongs to the "*nimia diligentia*."

But our attention must not be entirely engrossed with the part. In all classes of ulcers, the state of the system must be constantly regarded. As this deteriorates, so will the sore; and *vice versa*; indeed, a glance at the character of a sore is one of the best means of ascertaining the condition of the system; the ulcer telling as truthfully as the tongue, pulse, or countenance. In the treatment of the simple healthy sore, it is plainly our duty, therefore, with a view to the ulcer retaining its healthy character, until cicatrization be satisfactorily completed, to rectify error in the system, if such exist, and maintain it in a sound condition. The *primæ viæ* will especially claim our attention; cleansing away noxious matter by purgatives, amending secretion by alteratives, increasing tone by the suitable remedies, and directing especial regard to the suitableness of regimen.

The tendency of the simple sore, unless when over-stimulated either by accidental external injury or by malapraxis, is towards the second class, as already stated; and the prominent signs of change are to be found in the granulations, which become paler, taller, less sensitive and vascular, over-shooting the level of the surrounding skin; according to the common phrase, they are *exuberant*. This coming change is to be met by a corresponding alteration in the treatment; the water-dressing being medicated, so as, by exerting more or less of a stimulant quality, vigour may be duly maintained in the part and degeneration prevented. When the process of cicatrization is by any cause long delayed, however, the deterioration often does occur, in spite of our best efforts to the contrary. And so long as the exuberant granulations remain above the surrounding level, no progress can be made; for unless the old skin and granulating surface be on the same level, or nearly so, the new cuticular formation does not advance. The exuberance must be brought down; and for this purpose many remedies are in use. Escharotics may be employed; nitrate of silver, or sulphate of copper; the effect however is painful, not always easily limited so as to save the pellicle already formed, and not unlikely to be followed by over-action; undoing the granulating matter, by ulceration established afresh. Dry pressure is in all respects preferable; less painful; with ordinary care easily limited to the part desired; and not likely to exceed in its effect on the vascular system. A portion of lint or charpie is neatly laid over the sprouting granulations, carefully avoiding the surrounding pellicle of new skin—therefore always rather too small than too large—and if we wish to have the tender margins especially protected, we may cover them with thin pledgets of fine lint spread with simple wax ointment. This dressing is retained by a few turns of a bandage; not very tightly

applied, however, for the intention is not to induce vascular action sufficient to cause ulcerative disintegration, but merely such an amount of pressure as shall suffice to occasion absorption of the granulations, with a sthenic augmentation of vascular action around—far short of true inflammation. It is plain therefore that care is necessary not only in the adaptation of the compress, but also in the application of the retentive bandage; lest either or both induce a greater result than is suited to the object in view. A few hours' use of a gentle compress will sometimes suffice; in all cases, the dressing should be early undone, that it may be desisted from so soon as the desired result has been obtained; and then—granulations and skin being once more on a level—the simple protective dressing is resumed, and the cicatrization proceeds afresh. In certain situations, as the neck, the application of pressure may be inconvenient or altogether impracticable; under such circumstances, an escharotic is to be used gently.

2. *The Weak Sore.*—This is usually the result of the preceding; when, from any cause, local or constitutional, cicatrization has been delayed, and debility has usurped the place of sufficiency of action. The granulations are larger and less numerous than in the healthy sore; much paler, of a faint pink, or yellowish hue; taller, not of a decidedly conical form, and bulbous rather than pointed at the apex; less firm, and as if dimly translucent; little sensitive, bearing to be rubbed almost with impunity; less vascular, emitting blood but sparingly unless rudely handled; and the blood which does flow has often more of the venous than of the arterial character. In truth they are imperfectly organized. The discharge is pale and thin, the serum greatly predominating over the solid particles; there is but little fibrin, whether going to waste as pus, or going to repair, as granulations. The general character of the surface is pale, flabby, and elevated above the surrounding integument. This is often the seat of passive congestion, and sometimes of a serous effusion following thereon; consequently it is of a blue or livid tint, soft and somewhat swollen, though still below the level of the granulations; often its free margin is overlaid by a bending over of the tall granulating mass; and the surface of the latter not unfrequently parts with the granulated character, becoming uniform and villous in its appearance.

When the sore has been the seat of frequent change; ulcerating, because inflamed, one day; granulating well the second, and weakly on the third; the granulations coming and going, as it were; it is not uncommon to find the sore permanently assuming the weak character, and its integumental margins, having lost their support by the previous accessions of ulceration, are more or less inverted, as well as unusually dark by livid discolouration. This undermining and consequent inversion of the margin, is rather to be regarded as an accidental than as one of the ordinary characteristics of the weak sore. Sometimes the undermining is extensive at one or more points, matter accumulating there, unless when removed by pressure; and a probe passes readily into the cavity, which is marked by swelling and blueness of the integument.

All in short evinces a want of sthenic action; and this may either depend upon local circumstances, as already shown, or be but one

indication among others of a feeble system. No sore of large extent can escape degeneration into this form; it is the inevitable result of protracted cicatrization. A sore situated on the lower extremities—far from the centre of circulation, its venous return often if not habitually opposed, and all circumstances very favourable to passive congestion—is extremely prone to become weak. And not unfrequently such degeneration would seem to be connected with atmospheric influence; one day the majority of the ulcers in an hospital or ward may show a healthy character; next day they may all be weak or otherwise deteriorated, with no cause assignable, excepting perhaps the occurrence of a sudden and marked and unfavourable atmospheric change. Repeated ulceration of the same part, is a plain indication of debility there; and it need not surprise us to find that such sores invariably tend towards the weak character. Also, whenever the breach of surface has been originally caused by injury which entails debility of the surrounding parts, that debility is certain soon to show itself in the sore; as after bruise and burn.

Treatment.—Prevention being better than cure, it will be our object to prevent decline from the healthy condition, if circumstances place this within our power. The granulations getting pale, tall, and changed both in form and number, we abandon the simple water dressing, and have recourse to stimulants; gentle at first, lest over-action be induced; in avoiding one obstacle, we take care not to encounter another still more opposed to the healing process. The piece of lint, instead of being steeped in plain tepid water, is saturated with a solution of a stimulant nature, and reapplied in the ordinary way; sulphate of zinc, nitrate of silver, sulphate of copper, creosote, chloride of soda, are some of the excitants more commonly employed. Of these that which enjoys most favour, and in our opinion with justice, is the sulphate of zinc—in the form of lotion—which may consist of six grains of the sulphate of zinc, with two drachms of the compound spirit of lavender, and half a drachm of the spirit of rosemary, mixed in five ounces and a half of water; of course the flavouring ingredients may be varied in their proportions, to suit convenience or fancy. If this smart much on its first application, it is to be diluted with tepid water; gradually diminishing the amount of this, in proportion as increase of stimulus is required. It is well however that we have a number of such remedies at our disposal; for any one of them, used for a considerable period, loses its effect; and it is better under such circumstances to shift from one kind of lotion to another, than to increase the strength of the one originally employed. At the same time, moderate bandaging is applied; favouring, by its mechanical support, venous return, and a normal state of the general circulation in the part; affording also the salutary stimulus of uniform gentle pressure; and preventing the occurrence of passive congestion—a sure forerunner, if not an attendant on debility. The fulfilment of such indications by bandaging, carefully employed, is also plainly applicable to the treatment of the first class of sore which has been long open, and threatens in consequence to pass into the second. This with the medicated water dressing, and due attention to the system, will in many cases succeed in maintaining the characters of the first class, and

*Red
wash*

thereby much abbreviate the process of cure. And thus we find the remedies suited to the cure of this second form of sore, to be the same as those calculated to prevent its occurrence; differing only in degree.

Ointments were at one time much in vogue in the treatment of ulcers, both of the simple and degenerate kind; but are now almost entirely superseded by the water-dressing, simple or medicated, which possesses all the good qualities of the other, without any of the actual and possible disadvantages.

Should the judicious use of stimulant lotions fail to repress the tendency to exuberance of granulation, they are to be for a short time superseded by the compress of dry lint; when the level has been thus restored—and often it may be well to continue the pressure until the granulating surface is a little lower than the surrounding skin—their use is resumed. And under such circumstances we seldom omit the uniform and gentle bandaging, as an additional and well adapted means of maintaining due energy of action.

But local support is not alone sufficient. The general system requires our aid, as well. Secretion and excretion, having been found in order, or duly restored, nutritious regimen is enjoined; animal food, wine, malt liquors; given with a freedom proportioned to the power of digestion; and all sources of depressing influence are studiously avoided.

3. *The Scrofulous Sore.*—This class of ulcer is weak almost from the first; for it is only one indication, among others, of a system not only decidedly weak, but of such debility as establishes a decidedly vicious or cachectic state—that of scrofula. Such sores seldom occur singly, but in clusters; they are gregarious; at first distinct from each other, but ultimately becoming more or less confluent. The most frequent sites are, the neck, shoulders, arms, hips, lower limbs—especially in the neighbourhood of the articulations. The sores extend more in surface than in depth; yet their origin is not in the skin, as most other ulcers are, but in the sub-cutaneous cellular tissue. The commencement is made there by tubercular deposit, causing induration and enlargement, at first painless; then perverted vascular action sets in, of a higher grade than the merely nutritive, and the consequences are pain in the infiltrated part, increase of swelling, and redness of the superimposed integument, with the other ordinary signs of the chronic inflammatory process; imperfect suppuration takes place; the swelling softens and pits on pressure; by and bye fluctuation is felt, and the fluid is seen through the integument very much attenuated; but there is no regular pointing; almost the whole of the integument over the suppurated and infiltrated part becomes thin, blue, and translucent; it gives way partly by sloughing, partly by ulceration; and through the large, ragged, irregular aperture thus formed, the thin pus, with broken down tubercular matter, and portions of sloughing cellular tissue, is discharged. For some time no effort is made towards reparation; on the contrary, the thinned and blue integument still farther ulcerates, and the infiltrated tissue beneath still oozes away in the discharge. The surface has no granulations, and is of a dirty gray hue, surrounded by thin discoloured skin, undermined, inverted, and floating loosely

on the subjacent parts. After a time, some parts of the infiltrated tissue have been cleared away by disintegration or sloughing, and there granulations begin to appear; but they are of the weak kind, tall, pale, and exuberant. A probe, used even with much gentleness, passes readily through granulations into the boggy texture beneath, causing little if any pain, and but slight effusion of blood; or, following a superficial course, it finds integument undermined, and a ready communication so established from sore to sore. Around the cluster, there is usually a considerable amount of the products of the ordinary chronic inflammatory process; serum, and fibrinous effusion, the former much predominating; and this greatly increases the amount of general swelling, while it no doubt obstructs still farther all salutary effort towards reparation. The system, originally in a bad state, is worse now; sympathizing much with the local disorder, and usually evincing more or less intensely the ordinary signs of constitutional irritation; at first, during the inflammatory and softening process, there may have been an effort towards sympathy of a sthenic kind; irritative fever, however, is more likely to occur than the inflammatory; and the ultimate result is usually a hectic.

Such sores, if left to themselves, sometimes skin over, at least in part; imperfect clearance of the tuberculated texture having probably been effected by either ulceration or sloughing, or by both. But such cicatrix is very unstable, and certain to be undone at no distant period, disclosing a state of matters beneath not in the slightest degree amended. It is blue, soft, spongy, and elevated; whereas the true cicatrix is white, firm, and depressed. It is but as "the green mantle of the standing pool," which only for a time obscures the filthiness beneath.

Treatment.—It need hardly be said that the more important part of this is constitutional; attacking not one symptom of the disease, the sore; but the disease itself, the scrofula. The nature of that treatment need not be here repeated. Suffice it to say, that it must be steadily and patiently persevered in, not only during the cure of the local affection, but long after; otherwise immunity from speedy relapse can never be expected. Indeed, the most difficult part of the treatment will invariably be found to consist in preventing return of the sores, but lately healed; resumption of the erect posture, exposure to cold, a blow, excess in diet, too often suffice for early reproduction.

The local management requires to be energetic, and at first severe. Medicated lotions, ointments, poultices, will prove wholly unavailing in this class of sore. There is an unsound foundation for the reparative process, and that must be cleared away. The potassa fusa, in solid substance, is inserted boldly into the infiltrated cellular tissue; if the integuments have not already given way, they will readily yield before this; and then it is freely moved in various directions, so as to destroy thoroughly not only the cellular tissue where tuberculated, but also the integuments where thinned, blue, undermined, and obviously incapable of recovery. Also, it is made to pass from sore to sore, subcutaneously; and, used somewhat as if a cutting instrument, it effects destruction of the intervening integument. Ulcer after ulcer is thus treated until not only is each cleared of the dead and dying textures—

all these being by the escharotic at once converted into complete sphacelus—but the burrowing inter-communications are also freely exposed, and similarly freed from their unsound parts. It is, avowedly, a painful process, but most effectual; indeed, according to my experience, altogether indispensable towards obtaining a satisfactory cure. It should be done determinedly—rapidly yet carefully; and it is better to overtake the whole at once, than to temporize with partial instalments. The surrounding parts during the operation are protected by oil; and afterwards, oil is freely applied to the cauterized part, in order to assuage the pain, and prevent unnecessary extension of the escharotic effect; for we usually do not desist from the use of the potass, until tolerably certain that it has reached all the doomed texture; but little increase of the immediate slough, therefore, is desirable. Dark bloody discharge oozes out during the application, containing a considerable quantity of the escharotic in solution; this is carefully and constantly wiped away from the integument on which it comes. After such discharge has ceased, the whole part is covered with a poultice; and this dressing is continued until the slough has separated, disclosing a healthy granulating surface beneath—firm, red, vascular, and sensitive; then the water-dressing is assumed, and the local management afterwards conducted as for the first class of sore, into which the original affection has in truth been happily converted. On separation of the slough, however, should the appearance of the subjacent part not be altogether satisfactory—from insufficiency of the escharotic application, or from renewal of the tubercular deposit—more probably from the former—the potass is to be unhesitatingly reapplied, to such an extent as may be deemed necessary. Also reapplication comes to be expedient—and that not unfrequently—after reparation has somewhat advanced; on the slough's separation, a healthy granulating surface appeared, and all went on favourably for a time; but then came delay, then arrest, and afterwards degeneration; the part threatening to return to its former unsound condition. Early use of the potass, to a comparatively limited extent, arrests the degeneration; and in a few days the reparative process is vigorously re-established. But in order to avoid such repetitions, as far as possible, let the first application of the potass be determined and complete; rather destroying too much than too little; and never for a day let the attention be diverted from the constitutional management. After cicatrization, it is to maintenance of general treatment that we must look for prevention of relapse; along with uniform support afforded to the part, more especially when this is in the lower limb. Bandaging—or what is better, a laced stocking, with its part more slackly applied than the lower, in order to obviate congestion from venous obstruction—is under such circumstances a most valuable means of prophylaxis. And be it remembered that all cicatrices, more especially when extensive, and the result of sores defective in action, require much care, being by reason of recent and imperfect organism very liable to be undone by re-accession of ulceration.

4. *The Indolent Sore.*—Perhaps this is the most common of all ulcers; it is most frequently found in the lower extremities, and at a somewhat advanced age. It is invariably of secondary formation; this

condition of confirmed deficiency of both action and power having supervened on a state of matters widely different. The sore may have been at first healthy, then inflamed, perhaps thereafter irritable, then weak, and ultimately indolent; merely in consequence of cicatrization having been often opposed and long delayed, by the situation of the sore, and by the accidents to which it has been exposed. A weak system is often found co-existent, and may have had some share in the induction of the local apathy. From what has just been said, it can be readily understood how such sores should be most frequently found in the legs of the labouring classes; so frequently indeed, as to almost warrant a statement of the indolent sore being peculiar to that important class of the community.

The surface is excavated, smooth, glossy, pale, usually altogether void of granulation, sometimes sparsely studded by a feeble attempt at such formation. The discharge is thin and serous; containing but little fibrin, and the little which is effused passes off either in the form of pus globules, or in flaky masses not even so highly organized. The surrounding integument is both swollen and condensed, and discoloured by passive congestion, superinduced in the ordinary interstitial products of the chronic inflammatory process; and that which constitutes the margin of the sore is much elevated above the raw surface, round, dense, white, callous; in truth this is the most striking characteristic of the sore; which not unfrequently looks like a piece of pale mucous membrane, set in a dense and high ring of cartilage. It need hardly be said that such margins are not undermined, and neither everted nor inverted; but raised abruptly, a firm solid structure, the result of repeated accessions of the inflammatory process of a low grade and chronic character. Both sore and margins are comparatively insensible.

But usually the sore does not present the characters just enumerated, when first brought under our notice. So long as it is merely an indolent ulcer, the patient suffers little pain or other uneasiness, and continues his wonted avocations. But he receives a blow on the part, or is exposed to wet and cold, or other exciting cause of the inflammatory process is applied; inflammation is induced in and around the sore; he can work no longer, the erect position even is difficult, and he then applies for relief. Under such circumstances, the ordinary characters of the indolent class are seen, as it were, through an inflammatory medium. The surrounding skin is red, more swollen, painful, and even the callous margins are reddening; the raw surface is still low and void of granulation, but red and softening; the discharge is still thin, but bloody, and mixed with more or less disintegrated texture—for ulceration is soon re-established. By and bye, the part, being low in power, is overborne by the increased action; the margins as well as surface of the sore become converted into a slough, and as such are gradually detached. On separation of the slough, we expect to find a healthy surface beneath, so soon as the inflammatory and ulcerative processes shall have subsided.

The Mucous Sore, of some authors, is merely a variety of the indolent class, in which the raw surface, by reason of long persistence, has been thoroughly converted into a resemblance of mucous tissue; pale-

red, smooth, and villous; shining, as if varnished; with a limpid, quasi-mucous discharge.

Treatment of the indolent class of sores. As just stated, the part is usually presented in an inflamed state. The patient is put to bed, and a poultice applied to the sore and its vicinity. The tongue will be found heavily coated, and other plain indications of great derangement in the primæ viæ will not be wanting; an active purge, repeated if necessary, is therefore highly expedient. Low diet is enjoined; and if this, with the action on the bowels, be not quite equal to allay the inflammatory fever, which is likely to be more or less developed, antimony may be also exhibited. Thus, in a day or two—according to the ordinary phrase, a cleansing of the sore is obtained; that is, the slough, having become completed, separates by ulceration; the vascular action subsides from the suppurative and ulcerative grade—remaining in a more subdued, but yet exalted form, favourable to plastic effort; and, consequently, on detachment of the slough, a healthy surface is usually found beneath, demanding the mode of treatment suitable to the first class of sore.

When the sore is presented in the simply indolent state, two modes of treatment are in our option. *First*, we may imitate the process whereby Nature rids the part of its incubus; by induction of the inflammatory process. This may only induce ulceration of the previously callous surface, giving the granulating action on subsidence of the inflammatory; or by going a step further, it may more closely imitate Nature, converting all the parts which evince the indolent character into a slough, leaving the reparative action to follow on that slough's separation. For this purpose, a blister is probably the most convenient stimulus. Usually it is applied so as to produce the major effect; and after the requisite amount of inflammation has been induced, the treatment is the same as that already advised under similar circumstances of spontaneous origin. The only objection to this mode of treatment is that it is painful, and brings some hazard of inducing more action, as regards both extent and intensity, than is at all desirable; for be it remembered, both part and system are usually in such a state as to be both prone to the assumption of the inflammatory process, and unfavourable to its control. We may seldom fail thus to change the character of the sore; but occasionally—perhaps not unfrequently—it may be at the cost of establishing a worse disease, erysipelas. Besides, even supposing that such accident do not ensue, undoubtedly the first effect is to enlarge the raw surface; it is a larger though a better sore that we obtain; and it is not improbable that ere that wide space can be brought entirely to close, it may have degenerated, in spite of our best efforts to the contrary, into the weak, or perhaps once more into the indolent form. On the whole, therefore, as a general practice, the other mode of treatment is preferable.

Second.—By continued pressure the surrounding elevation is to be undone, and the villous surface changed into a granulating sore. The first part of the manipulations is, to support the whole of the limb below the ulcerated point by moderate and uniform bandaging; if this be neglected, congestion must ensue, and more serious consequences are

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not unlikely to follow thereon. Then a strip of the common adhesive plaster, about one inch in breadth, or rather less, is applied with tolerable tightness over the lower part of the sore; crossing the ends over this, the centre of the strip having been applied to the opposite point of the limb. Plaster after plaster is thus adjusted, until we have invested not only the whole open surface, but also a little of the unbroken skin both above and below. The bandaging, which had stopped to admit of the application of the plaster, is then continued, covering the whole limb, from the very distal extremity to about a hand-breadth above the seat of the ulcer. The limb is then placed in an elevated position, and for some hours this, as well as the general recumbent posture, is strictly maintained. A feeling of constriction, sometimes amounting to actual pain, is usually complained of; but seldom lasts long; and still more rarely does it by persistence render an undoing of the dressing necessary; it is sufficiently met by rest and the elevated position of the part; or, should this fail, affusion of cold water will suffice to restore comfort. After two days—not earlier, unless symptoms of inordinate vascular action have manifested themselves—the bandage is undone; a grooved director is insinuated beneath the plaster, at the point opposite to the ulcer; on this the strap is cut; the dressing is then gently removed; and according to the change which has been effected in the sore, is the same dressing repeated, or another substituted more suited to the characters which the sore now presents. When the sore is large and discharge profuse, a slit may be made in each strap, where it crosses over the ulcer, in order to prevent purulent accumulation.

By the continued pressure on the callous margins, absorption is instituted there—partly interstitial, partly continuous; and thus they are gradually brought down from their undue exaltation of level. By the same agent acting on the villous surface, this is broken up by disintegration; for pressure which only causes absorption in an unbroken part, is equal to the induction of ulceration in that which is deprived of integumental protection; by and bye, this destructive action ceases, the part becoming habituated to the stimulus, which is gradually lessening by yielding of the dressing; granulation succeeds; and thus the raw surface mounting up, while the surrounding integument is descending, the equal level requisite for cicatrization is gradually approached. For the stimulus continues to act both on the skin and sore; causing absorption in the one, and maintaining vigour of vascular action in the other. As formerly explained, pressure in a slight dose, excites the absorbents chiefly; in a greater, arouses vascular action of a sthenic kind, short of true inflammation; a still larger dose reaches the true inflammatory acmè, bringing suppuration and ulceration. Here the same dose is applied to both margins and sore; but the latter is less tolerant than the former; and in regard to the latter the same pressure is practically equal to a higher dose, than that which is operating on the margin. Hence we have only absorption in the one, and in the other vascular excitement of a sthenic type.

Besides, the mechanical effect of the circular band, is to draw together the sound parts on the sore, and thus greatly to favour not the

least portion of the cicatrizing process—that is the centripetal movement of the original tissues.

Sometimes, when the edges are very high, and the sore deep and small, the plaster reaches only the margins at first, the raw surface escaping by their interposition; a certain amount of salutary stimulus is nevertheless conveyed to the latter; and on subsidence of the skin the pressure comes to act on both in the usual manner.

In all cases, it is very apparent—by regard to the *modus operandi* on the raw surface—that the amount of pressure must be carefully regulated. At first tolerably severe, to induce absorption and disintegration; afterwards more moderate, lest the vascular action be overdone, and the reparative effort on the raw surface be opposed rather than advanced. Much in the same way as we found it advisable to regulate pressure, gradually diminishing its amount, in the treatment of sinus. At first we want change of structure, and an aroused action; afterwards a maintenance of action, neither too high nor too low, but sufficient for the purpose of progressive repair.

The dangers plainly are, over-action, and strangulation of the limb—even although the latter be provided against by previous careful bandaging. Both will be prevented by a very simple proceeding; making a section of the mass of plaster, after it has firmed on the part, on a grooved director introduced at the point opposite to the sore. This is sufficient to relieve constriction, and to moderate pressure; the beneficial effects of pressure are not foregone, while danger is obviated; and besides, the resilience of the plaster to the opposite point from that cut plainly augments, and not inconsiderably, the important centripetal action of the integument, and cellular tissue around the sore. This, therefore, apparently a trifling and perhaps detracting circumstance, is in truth an important and corroborating addition to the manipulation; and ought seldom to be omitted. The strap is first firmly applied; then allowed a few minutes to consolidate, and tightly embrace the limb; and then the section is made.

Another advantage of this second mode of treatment is, that although more progress is likely to be made in the recumbent posture, yet it is not essential that this should be uniformly maintained. For a few hours after adjustment of the dressing, rest is indispensable; but afterwards the erect posture may be resumed, and wonted avocations therewith—a point often of the utmost consequence to the patient; such resumption may delay the cure, but will not prevent it. Sometimes this mode of dressing may be continued, on almost each occasion less tightly applied; but very frequently the character of the sore changes so very decidedly for the better, after one or two applications, as to call for corresponding change of treatment to the simple dressing suited to the simple and healthy sore.

Throughout the cure, the system is duly attended to; the diet is generous; and it may be that tonics and even stimuli become expedient; for little good can be expected to follow on the most skilful treatment of the part, unless the general frame be provided with sufficient power to maintain the reparative action. In the opinion of some, small doses of opium—half a grain night and morning—are of use in maintaining

energy of the capillary circulation, more especially when the patient is far advanced in years.

After cicatrization, local support, by bandaging or a laced stocking, is not to be omitted; otherwise relapse is but too probable. A small circular aperture appears near the centre of the cicatrix, as if made by a pin's point; this rapidly enlarges; and the sore may assume the characters either again of the indolent or of some other variety.

5. *The Irritable Sore.*—This is an example of irritation supervening on the products of inflammation; usually of secondary occurrence; and the result of accident, of malaprxaxis, or of a depraved state of system. The sore is almost invariably superficial, not penetrating more deeply than the true skin; in fact, this texture may be said to be the peculiar site of this class of ulcer; and this circumstance may in part account for the great sensibility of the sore. The surface is unequal, deeper at some points than others; it is void of granulation, and either of an angry dark-red fleshy hue, or covered with a grayish film of tenacious aplastic fibrin; sometimes this covering only partially invests the surface, which then shows both the red and gray appearances. The edges are thin, serrated, and everted; of a red angry hue, and sometimes studded with brightly florid points as if of arterial blood. The surrounding skin is slightly swollen, and also of a dull red colour, being in a state of passive congestion; or perhaps, rather, not yet recovered from the chronic inflammatory process. The discharge is thin, acrid, bloody, often mingled with solid matter—either recently effused, or from disintegration of the old. Pain is constant, always considerable, often excessive; the slightest interference with the acutely sensible surface is followed by intense burning pain, and by a copious flow of blood, usually of a dark grumous character; as if the injury were resented, instead of being merely acknowledged as in the healthy sore. Generally an irritable state of system precedes and accompanies this state of the part; but even when no such predisposition exists, that morbid condition of system is almost certain to occur—an example of constitutional induced by local irritation. And along with the ordinary symptoms of the constitutional form—more especially restlessness, want of sleep, loss of appetite, emaciation, general disorder of secretion—there is often a remarkable peevishness of temper unhappily combined.

This kind of sore is liable to occur any where; more especially if it follow on eruption, as it very frequently does; but its most frequent locality is on the lower limbs, on the shin, and near or over the ankle. It is not unlikely to pass into the next class of ulcer; an example of what is not unfrequent—irritation inducing inflammation.

Treatment.—This is partly, and sometimes mainly, constitutional; the predisposing, if not the exciting cause is in many cases to be found in the system, and must be opposed by the suitable remedies; with this view the *primæ viæ*, and general secretion, will especially claim our attentive regard. In other respects, the treatment suitable to constitutional irritation is maintained, along with the local management. This consists of rest, quietude, elevation and relaxation of the part; and such applications are made use of as we formerly saw to be most advisable in cases of irritation. Of these, none are so generally useful

as the nitrate of silver; applied lightly to the raw surface; with *some* intensity to the margins, so as to produce a slightly escharotic effect there, and bring them into a form more suitable for the commencement of cicatrization; and pencilled, again lightly, over the surrounding skin, where swollen and discoloured, so as merely to blacken this, and obtain the sedative and purely antiphlogistic effect. A temporary increase of pain usually follows in the sore, but soon passes away, on the application of a soft light poultice, or the hot water-dressing; and this epithem is continued until the re-application of the nitrate; which may be daily, or only on each alternate day, according to the effect produced. Under this treatment, amendment is often rapid and satisfactory; pain diminishing, and soon ceasing to be inordinate, the margins losing their irritable characteristics, and the raw surface beginning to be studded with healthy granulations; then the ordinary simple treatment is assumed. But success is not invariable; the pain may be permanently increased by the application, and the sore either becomes more and more irritable, or threatens to pass into the inflamed. In such circumstances more simply sedative means must be applied to the sore, the pencilling by nitrate of silver being still continued however to the surrounding integument. An aqueous solution of opium may be used, five grains to the ounce; conium, hyoscyamus, belladonna, or aconite, cautiously; and sometimes good effects are produced by a weak nitric-acid lotion—from two to five drops to the ounce of distilled water. When the sore is secondary to cutaneous eruption, a weak solution of arsenic is often very beneficial; and in such cases it is well to combine the internal with the local use of this remedy. But in my opinion, neither arsenic nor nitric acid are suitable as early applications to this kind of sore; they are apt to stimulate instead of soothing; and should only be had recourse to as alteratives, after the characters of the sore have been somewhat modified by the previous use of more appropriate, because more truly sedative remedies. If even these fail to relieve, much benefit will sometimes follow continued exposure of the part to steam of hot water, of as high a temperature as can be conveniently borne. Should the light application of the nitrate of silver fail to remove congestion from the surrounding skin, leeches or punctures may sometimes, though rarely, be required.

On the whole, as already stated, the most trustworthy and generally applicable local remedy is the nitrate of silver; used not oftener than daily, and usually but once in the forty-eight hours; applied with great lightness to the raw surface and surrounding skin, so as only to produce its slightest effect—the very opposite of escharotic—sedative, anodyne, and protective by the formation of an investing pellicle on the sore; pressed firmly only on the margins; and they too come to be but tenderly dealt with, so soon as they have undergone a favourable change.

6. *The Inflamed Sore.*—This presents the ordinary characters of advancing ulceration, with accompanying inflammatory action; and, as can be readily understood, is the most common original form of ulcer. Very often, however, it is of secondary occurrence; for over-stimulation is not unlikely to happen in the treatment of ulcer of a healthy, or even of a sluggish kind. The raw surface is gradually disintegrating; and

instead of contracting, steadily enlarges ; showing no granulations, but a soft, raw, pulpy substance ; and emitting a profuse ill-formed pus, mingled with the ulcerative debris. The margins are swollen, red, hot, tense and painful ; and so is the surrounding integument. The erect posture and motion increase the pain ; the system is more or less involved in febrile disturbance of the inflammatory type ; and the primæ viæ are usually found in marked disorder. Not unfrequently, the action running high, while local power is weak, sloughing takes place, more or less extensively ; as already noticed in regard to inflammation supervening on the Indolent variety of sore.

The *treatment* consists of moderate antiphlogistics. Rest, relaxation, elevated position, fomentation, poultice, hot water-dressing, antiphlogistic regimen, purgatives, antimonials. Sometimes it is necessary to draw blood locally ; and this may be done by leeches or punctures. The former are sometimes placed on the sore itself, with a good effect ; and this practice may also occasionally prove beneficial in the irritable sore, when following on the inflamed, and surrounded by considerable and somewhat active congestion. Punctures are preferable, however, in the integument ; for leeches there are apt by their own irritation to induce a spreading of the inflammatory process, of an erysipelatous kind ; or the bites may themselves assume the ulcerative action, and so extend the original disease. Let not, however, the antiphlogistics, even when moderate, be continued one moment longer than is absolutely necessary, otherwise degeneration into the weak sore is speedy and certain : let it be always remembered, that a part once truly inflamed, is ever after defective in vital power.

7. *The Sloughing Sore.*—This differs from the sloughing state which not unfrequently attends on the simply inflamed, in being not a casualty and temporary, but an inherent characteristic of the disease—which usually begins with the formation of a slough, and continues to enlarge by repetition of the same process ; the result of local vascular excitement, occurring not only in a part but in a system of diminished power. Such action is in itself not great, and in a sound texture would probably lead to no higher result than simple exudation, but in a worn frame and weak part vital power is almost instantly overborne, and almost the first indication of the action's presence is supersedence of vital by chemical change. Thus the inflammatory process instituted in the sexual organs of ill-clothed, ill-fed, intemperate, abandoned prostitutes, living in the densest and filthiest parts of dense and filthy cities, is very apt to produce this kind of sore. Here the local and general debility exists before the application of the exciting cause. But the relation may be reversed ; the cause may be capable of exerting such a depressing influence on both system and part rapidly, that the inflammatory process which it excites very speedily terminates in gangrene ; as happens in inoculation of certain poisons ; that of venomous snakes ; of diseased animals, producing "malignant pustule ;" of certain forms of venereal virus, establishing the most formidable kind of that disease.

Or the inflammatory process may itself induce a change in the part affected, inimical to power, and favourable to predominance of action.

Thus, a sore on the penis may be of a simply acute nature; paraphymosis ensues, in consequence of the surrounding inflammatory swelling; change of relative position is neglected, consolidation takes place, and then attempts at reduction are unsuccessful; the constriction is neither so great nor so complete as to produce complete sphacelus of the whole glans, but it is sufficient to establish slough after slough on the breach of surface. And this is an example of what may be termed the secondary sloughing sore; not commencing with a slough; but an ulcer, passing into that condition, and remaining so degenerated.

The originating slough is sometimes dry, sometimes moist; according to the rapidity with which the destructive process has advanced. Usually great humidity is one of the most characteristic features of the sore. When dry, the case may be termed a chronic form of the disease, by far the less frequent in occurrence. Sometimes, after a dry commencement has been made, a rapid transition takes place into the humid form; the discharge commencing when the first slough begins to separate, and soon becoming profuse. Much pain attends; whatever may have been the previous state of the system, there is soon much constitutional irritation; and at the same time the *primæ viæ*—by loaded tongue, fœtid breath, &c.—generally indicate very prominent disorder. Not unfrequently—as in the malignant pustule—a vesicular or pustular condition of the surface briefly precedes the actual death of the part.

A superficial slough having fairly formed, it begins to be detached. Its edges loosen, and expose the subjacent parts; but these instead of showing the red fleshy granulations of repair, or even the angry aspect advancing ulceration, disclose but a new formation of slough, soft and tawny; and thus gangrene upon gangrene may succeed—in strata, as it were—until the part has been frightfully mutilated, and the system brought into the most alarming disorder. The surface is generally of an ashy hue; sometimes inflated by gaseous extrication; sometimes darkened by commixture with a grumous bloody serum. The discharge is thin, fœtid, sanious, usually very profuse, giving the characteristic humidity, and mingled with putrid solids partially dissolved. Not unfrequently hemorrhage takes place; profuse; arterial or venous, more frequently the former; the sloughing, unpreceded by interstitial and plastic deposit, having opened a vessel of considerable size and activity. The result of this bleeding is sometimes beneficial, sometimes highly hazardous; the former, if it affect only the part, critically resolving the action; the latter, if it affect not only the part but the system, depressing still further the powers of life which are already too low; fatal results from this cause have not been unfrequent.

There is every reason to believe that this form of malady is contagious; that the secretion from a sore of this kind applied to a healthy ulcer, or perhaps even to an unbroken portion of skin, may induce a state similar to the original.

8. *The Phagedænic Sore*.—This is a spreading ulcer; destruction advancing more determinedly than in simple ulceration, however acute; but still by molecules, not by masses as in sloughing. It results from a somewhat similar conjunction of circumstances with the preceding;

local action exceeding local power, and usually attended with debility as well as irritability of the system. Two forms occur; the acute and chronic.

The acute is usually a sore of irregular form; with margins abrupt and somewhat ragged; and these as well as the integument to some distance around, the seat of active vascular action, are red and slightly swollen. The sensation is of a sharp burning heat. The raw surface is of a brownish hue, totally void of any thing like granulations, of uneven depth, and in many places presenting the appearance as if gnawed by the tooth of a small animal. The system suffers severely; and the form of disorder is that of constitutional irritation.

The chronic variety is less painful, less inflamed, less rapid, darker in hue, with the gnawed appearance usually more distinct, commonly surrounded by considerable induration, and often spreading at one aspect, while slowly cicatrizing at the opposite; withal the constitutional disturbance is less severe.

9. *The Sloughing Phagedæna*.—The acute phagedænic sore seldom persists in a distinct form; much more frequently it is associated with the sloughing, constituting sloughing-phagedæna. Commencement may be made by either. If the phagedæna have preceded, the sore becomes lighter in colour, with margins less distinct, temporary diminution of discharge, and perhaps a lull in the pain; a thin slough forms; this begins to separate, discharge again becomes profuse, and on separation having somewhat advanced either a second slough is seen being formed, or the part is found yielding before re-accession of phagedæna. Sometimes the alternation of slough and ulcer is tolerably regular; in other cases one or other form of destruction may have the predominance. The constitutional disturbance is at least equally severe as in either the sloughing or acute phagedæna, uncombined; indeed, very frequently both part and system suffer more in the combined form, than in either singly. The combined is less frequently original, than either of the separate forms.

Familiar examples of the sloughing ulcer may be found in the malignant pustule, and the sloughing sore of the penis; of the phagedænic, in the lupus of the face, and the phagedænic form of the venereal disease; of the sloughing-phagedæna, in the hospital gangrene or sore, and cancrum oris. In all these varieties, but more especially the last, the discharge is remarkably fetid; and so strikingly peculiar is the fœtor as to constitute one of the most prominent characters of the disease; poisoning thoroughly the atmosphere of even a large apartment, and felt oppressive at a great distance.

Treatment.—The treatment of these three classes, being in most respects identical, has been reserved till now. It is both constitutional and local. The primæ viæ almost invariably showing signs of oppression, a purgative, not over active, is exhibited; and some antimonial may be at the same time given, should there seem any effort towards a sthenic form in the constitutional disorder; if there be, it will only be at the commencement, for very soon irritation is the decided type. When the tongue begins to clean, and the patient looks lightened by the evacuation, then the treatment peculiar to constitutional irritation

should come into play; and the best medicine in my experience, under such circumstances, is the pulv. ipecac. c. opio, in doses of ten grains, or thereby, given three times a-day: it relieves the secretions, assuages local pain and general irritation, brings down the pulse, gives sleep, and obviously exerts a most beneficial influence on the local disease; and should this by persistence demand repetition of painful remedies, it is well to give an additional dose of the powder at each such repetition, to allay pain and prevent the general irritation from being reintroduced. Atmospheric influence should also be attended to; in many cases—more especially when this form of sore is of secondary accession—this would seem to be the predisposing, if not the exciting cause of the disease; and whenever circumstances give rise to such suspicion, the patient ought of course to be carefully excluded as much as possible from the operation of such untoward agency. The diet should be good yet non-stimulant; in the first instance, at all events, restriction to the farinacea will be expedient.

As to the local management, surgeons are not yet quite agreed; one party advocating the most lenient measures—poulticing, rest, and expectancy; while another are in favour of severe and active remedies—escharotics—at the outset, in order to cut short the disease, and—along with the suitable constitutional treatment—to change the character of the sore into the healing type. Among the latter I confess myself to be enrolled; and simply because my experience of both gives, to my perception, a decided superiority to the energetic over the expectant system. One reason why some have lost faith in the active remedies I believe to be, that these have not been efficiently applied. Great humidity has been already stated to be a prominent characteristic of the majority of such sores. An escharotic applied to the parts unprepared, proves almost inert: for it is dissolved by the fluids, and passes off after having but grazed the solids. The first, and a most essential, part of the manipulation is to dry the surface and parts around thoroughly, by tow or lint, gently yet firmly applied; at the same time loose sloughs are taken away, and the thickness of adherent dead parts diminished, by scissors. Thus, and thus only, is the sore prepared to be duly affected by the escharotics. Of these, two are most in favour; nitric acid, undiluted; and a strongly acid solution of the nitrate of mercury. The former seems the more adapted for general use; and is certainly preferable for the first application, being equally effectual in forming an immediate and sufficient eschar, and followed by a considerably less continuance of pain. A flat piece of wood, or a director wrapped round at the extremity with lint, is soaked in the acid, and then pressed firmly on every part of the affected surface, as well as on the yet living margins; continuing the application until all has been converted into eschar; and protecting the surrounding integument, by carefully wiping up the fluid product. The part is then covered by a soft warm poultice; this application is continued until the eschar begins to separate, when it may be conveniently superseded by the warm water-dressing; and not unfrequently this may be slightly medicated by solutions of the chlorides of lime or soda, as correctives of fœtor, and detergents. So soon as detachment has begun, a careful and anxious examination is

made of the subjacent part, more especially at the very margin, in order to ascertain whether the sloughing action has been arrested or not. If it has, a healthy surface will be found, either simply ulcerating, or already showing signs of repair by granulation; and the simple water-dressing is continued. If it has not, the ash-coloured slough will be found again forming, or else rapid destruction is seen advancing in the phagedænic form; and the escharotic must be at once and freely repeated, directing its operation chiefly to the margins, as there the chief tendency to extension of the evil would seem to reside. And if need be, such repetition is continued, until the destructive action has been finally and fully controlled. In the reapplications the nitric acid may be well superseded by the nitrate of mercury; not as a more efficient escharotic, but as a more successful *alterative* of the nature of the sore; it is liable to but one objection, namely, that a burning pain is not unlikely to continue for several hours; this is in part obviated, however, by the simultaneous exhibition of the internal sedative and anodyne, as formerly advised. In no instance should the preparatory drying of the part be omitted; it is as necessary in the last application, as in the first. Be it likewise remembered, that this class of sores is communicable by contagion; that consequently much personal cleanliness is demanded towards each patient; and that in hospital practice, all community of dressings, and every other circumstance likely to effect conveyance of the contagious matter, must be scrupulously avoided.

On the arrest, even partial, of the sloughing and phagedænic processes, by the local treatment, the constitutional symptoms undergo a marked improvement. For the effect of the escharotic is not merely to convert both dead and dying parts at once into an eschar; but also, by changing a soft, pulpy, semi-fluid mass, into one which is comparatively hard and dry—at the same time establishing a sthenic inflammatory, and ulcerative process, for the dead part's separation, in the comparatively sound texture immediately beyond—a process unfavourable to absorption—the maintenance and increase of constitutional contamination from the absorption of deleterious matter, both fluid and gaseous, are obviously diminished. When the sloughing has ceased, when the sloughs are almost separated, and when granulation is fairly established—the characteristic humidity, fætor, and pain, all gone—the febrile disorder will be invariably found to have greatly subsided; then tonics and generous diet have become expedient, to allay the hectic tendency, and maintain constitutional power sufficient for local repair.

Such being the treatment most suitable to this class of sores, it is very obvious how important it must be in all cases, to diagnose accurately between what is really of this nature, and the mere simulation by accidental sloughing in the simply inflamed ulcer; the one requiring a painful escharotic, with the treatment suitable to constitutional irritation; the other, merely continuance of bland poulticing, with moderate antiphlogistics.

It need scarcely be added that in no instances of the genuine form is blood-letting advisable; as already seen, local loss of blood sometimes occurs in the progress of the disease; occasionally for good, but per-

haps more frequently for evil; in all circumstances it is certainly an event of much hazard, with a leaning to the side of evil sufficient to forbid its rash institution by the practitioner.

Mercury, too, is not to be thought of. As a general rule, in sloughing and phagedænic sores, more especially when of venereal origin, mercurial medicines are always to be withheld; as certain to prove more or less pernicious—in many cases disastrously so. The disease is aggravated. Indeed, supervention of the constitutional disorder attendant on mercurial exhibition, is often the obvious cause of comparatively healthy sores degenerating into the sloughing or phagedænic forms.

Escharotics, it will be observed, have been spoken of as applicable only to the scrofulous—potass; and the sloughing and phagedænic—nitric acid and nitrate of mercury. But in some cases of both the weak and the irritable sores, especially when attendant on marked constitutional disorder, should the characters obstinately remain perverse, notwithstanding due perseverance in the ordinary mode of treatment, escharotic destruction of the irretrievably diseased parts may be effected, with a good hope of finding, on separation of the slough, a sound foundation for repair.

Peculiarities of Ulcers.

Many sores on the lower extremities are accompanied, or rather caused by—at least in part—a varicose condition of the veins; and by some the “*Varicose Ulcer*” is entered into the general classification. But in truth this term does not express any individual kind, but rather comprehends every variety of sore; for all, or almost all, may be attended by, and partly result from, a varicose condition of the veins. The irritable is very common under such circumstances; so is the inflamed. The indolent and weak, especially the former, are said by some to be the types of the most frequent examples of the varicose ulcer; but according to my experience, neither are more common than the irritable. Occasionally the scrofulous is found complicated with varix; we may have even the sloughing and phagedænic—and in that case profuse venous hemorrhage is to be expected and guarded against. Perhaps the least frequently accompanying is the healthy sore—as can be easily understood, when it is remembered that varix and passive congestion are all but synonymous, and that this state is very unfavourable to all sthenic and salutary vascular action.

The treatment will necessarily vary according to the character of the sore, independent of the varicose complication—poulticing and rest to the inflamed, stimulants to the weak, nitrate of silver to the irritable, straps to the indolent, &c. But, besides, it is of course essential to deal with the obvious predisposing cause, the varix. If this be great and of long standing, and have induced oft-repeated ulceration of a troublesome and grievous nature, the radical cure of the varix ought certainly to be attempted, in the way which will be explained when speaking of the treatment of this disease. But as this requires confinement for some time, and is not altogether void of danger, in the slightest

and more ordinary cases the prudent surgeon contents himself with the palliative management; that is, by rest and recumbency during the ulcerating and healing processes; and by uniform support, from bandaging or a laced stocking, both then and subsequently. Even during the acutely ulcerating, and even in the phagedænic form of sore, a certain degree of support is advisable—slight, uniform, and never amounting to direct pressure on the raw surface—in order to obviate accidents by the sudden occurrence of hemorrhage. At the same time much attention is paid to the lower bowels, keeping them clear of obstruction, and thereby removing a cause, not more obvious than common, of occurrence and continuance of varix in the lower limbs.

2. The lodgement of *foreign matter* may complicate the ulcer, effectually preventing cicatrization. This may have come from without, and consist of wood, stone, iron, cloth, &c.; by impaction originally causing inflammation and abscess; and then by delaying contraction of the open suppuration, establishing the condition of ulcer. Or it may have an internal origin; consisting of necrosed bone, dead tendon, or ordinary slough of fascia or cellular tissue; the result of suppuration, either then or previously. Of whatever nature, and whencesoever come, the foreign body is always amenable to but one treatment—early and complete removal. Some little excitement follows the manipulation necessary to effect that object, and is to be met by rest, fomentation, poultice, and other usual antiphlogistics; on subsidence, the granulating process begins, and is conducted under the ordinary treatment.

3. The condition of *sinus* may co-exist with that of ulcer, preceding or accompanying. If it fill not up and contract spontaneously, keeping pace with the corresponding change in the sore, it is to be treated independently. Pressure in the first instance is applied, direct, and regulated according to the principles formerly inculcated. If this fail, then the sinus—usually very superficial—is to be laid open, either by the knife, or by the potassa fusa, as circumstances may render expedient. If the term sinus be applied to the undermining of integument, and unsoundness of cellular tissue, which invariably characterize the scrofulous sore, then the use of the potass to these will be invariable, for the reasons formerly given.

4. Sometimes sores are *vicarious* in their nature. In females, for example, ulcers may form on the leg, or elsewhere, obviously connected with the menstrual secretion; becoming active, enlarging, and emitting a profuse discharge—sometimes sanguinolent—while the menstrual flux is, or should be, in progress; contracting, becoming dull, comparatively dry, and perhaps partially cicatrizing during the intervals. Such sores, it is plain, can be attacked with safety only through the uterus. The functions of that organ must in the first instance be duly restored: then, and not till then, our attention is to be directed to the obtaining of cicatrization.

5. *The healing of certain sores is never to be attempted.* For example, when a sore has existed for many years, almost stationary, or only varying with obvious changes in the system; tending to inflame and extend, during constitutional disorder, contracting again when this sub-

sides, yet never approaching to complete cicatrization without ill health ensuing—and this again relieved by re-establishment of the sore. When the gouty diathesis is strongly marked, and its alternations are plainly connected with the ulcer's varying state. When the patient is advanced in years, has been in hot climates, and may without injustice be termed a *bonvivant*. Under these circumstances, or such as these, we do not think of drying up the sore—which may be truly looked upon, somewhat as a safety valve to the system—but content ourselves with the application of some simple and soothing dressing, such as the wet lint and oiled silk; leaving what may be termed the ebbing and flowing of the ulcerative process entirely in the hands of Nature; our dressing tending simply towards comfort and protection.

6. Some sores may be healed with safety, but only when an *issue* for some time supplies their place, as a drain in the general economy. A sore, secreting constantly a considerable quantity of pus, may have existed for years in the limb of an elderly patient. No prudent surgeon would ever propose to dry up that suddenly by rapid cicatrization—if he had it in his power so to do—without leaving some substitute in its room, at least for a time. For the sudden cessation of purulent discharge, to which the system had been long habituated, would be certain to occasion a plethora; this in its turn inducing determinations of blood to certain parts; and thus serious danger to the important internal organs would accrue, by hemorrhage, sanguineous infiltration, or establishment of the inflammatory process. Apoplectic seizure is especially probable under such circumstances. Yet doubtless the continuance of such a sore is not only a considerable inconvenience, but likewise has a debilitating effect on the general system, and consequently tends to the induction of diseases to whose accession constitutional debility is favourable; its closure is therefore desirable. And should none of the unpropitious circumstances exist, as stated in the preceding paragraph, such closure may be safely enough conducted in the ordinary way; taking care, however to establish an issue in some convenient and adjacent spot, so soon as the discharge begins to materially lessen. This artificial drain is kept in full operation for some time—a fortnight or three weeks—and then, by gradually diminishing the bulk of the foreign body by whose presence healing is prevented and discharge maintained, the system is so gradually subjected to the diminution of the waste, that its ultimate cessation is scarcely appreciated.

7. Ulceration is a very frequent attendant on malignant disease; and is then termed malignant or cancerous. This will be considered in an after part of the volume.

CHAPTER VI.

MORTIFICATION.

HAVING already considered the nature and progress of mortification in general; and more especially that very common form which is the highest result of the inflammatory process; we now proceed to notice other causes of this serious change, and the treatment to which the disorder is amenable.

As to *terms*;—the ordinary division of the subject is into *acute* and *chronic*; the acute comprehending the humid, inflammatory, and traumatic; the chronic—the dry and idiopathic. Generally speaking, the acute is humid, and the chronic dry: the fluids being retained in the one case, and parted with gradually in the other; but this is not invariably the case.

The *cause* of mortification may be broadly stated to be, whatever is hostile to vital power. But it will be convenient to examine this statement more in detail; considering separately those causes of local death which most frequently come under the notice of the surgeon.

1. *Inflammation*, we have already seen to be a very frequent cause of mortification; by intensity of action; by want of vital power—in part, system, or both—to control action, otherwise not excessive; or by a conjunction of both circumstances. The gangrene may be said to be invariably humid; for not only is there no dissipation of the normal fluids of the part, but an absolute and decided increase of them by the inflammatory effusion.

2. *Mechanical injury* may occasion local death either directly or indirectly. The violence may have been so great as at once to crush and disorganize the part, instantly depriving it of life. Or, less intense, it may have but lowered vitality by partial disruption of texture, at the same time acting as a palpable exciting cause of the inflammatory process therein, and so rendering the occurrence of gangrene by inflammation all but inevitable. Both forms are sufficiently common; and both, but especially the latter, are prone to spread rapidly, greatly endangering life by poisoning of the system. The mortification is acute and humid.

3. *Pressure*, gently applied, occasions absorption; a higher grade causes vascular action in a perverted form; a higher gives the true inflammatory products, suppuration and ulceration; and a higher still occasions death of the part. The last result may be either direct or indirect; that is, with or without the intervention of vascular action. Pressure being considerable and constant, with a low power in both part and system, death of the former may be immediate; as may often be observed in the formation of bed-sores in the helpless and bed-ridden.

den. Or, as was stated of mechanical injury in general, the pressure may excite the inflammatory process and lessen vital power simultaneously, so rendering the part an easy prey to the former.

4. *Heat*, in like manner, may be so intense as at once to char the part, rendering it instantly dense, black, and brittle, as in the severest class of burns. Or it may only diminish power and excite inflammation, as in the more common examples of this form of injury. *Acids*, and other chemical destructives, act in a similar way.

5. *Obstruction to Venous Return*.—The gangrenous effect of this is indirect. Passive congestion is induced; and so long as the obstacle to venous return continues, the venous accumulation, with consequent effusion into the surrounding parenchyma, is inevitably increased. This abnormal state, necessarily weakening vital power, is also likely to excite the inflammatory process, as formerly shown; and but a slight amount of action will suffice to overpower in such circumstances. Thus, gangrene of the whole forearm has resulted from injudicious bandaging, or other deligation, of the arm, no support having been afforded to the parts beneath. Retain the tight ligature used for venesection, and gangrene will be certain sooner or later to ensue—through the intervention of inflammation. Or the obstruction may be by spontaneous change in the principal venous trunk, it becoming solidified by coagulation of its contents, or by fibrinous effusion; or from compression by tumours of various kinds; or by organic change in internal organs—as the liver and heart.

6. *Deprivation of Nervous Agency*, also acts indirectly. Bed-sores by sloughing are well known to be most prone to form, in cases of injury of the spine; the pressed parts being paralytic. Power is diminished, a tendency to action is induced, and the application of a comparatively slight stimulus suffices to ensure the gangrene. Sometimes no direct employment of exciting cause is necessary; the cornea has sloughed after division of the fifth nerve; the same act at once arousing action and cutting off the nervous agency.

7. *Interruption to Arterial Supply*.—This may be complete, causing a direct cessation of life. A tourniquet screwed so tightly on a limb as to arrest entirely its circulation, and so retained, inevitably entails death of the whole limb beneath the encircled point; for, invariably, on complete arrest of circulation, vital action ceases, and chemical change speedily begins. Besides, ordinarily, arterial influx can only be effectually arrested by such means as will at the same time cut off all nervous influence; rendering retention of vitality, if possible, still more hopeless. Or, the instrument may be applied with tightness sufficient to diminish, yet not to stop arterial influx; and then the result will be indirect, as in the case of obstruction to venous return only; action being excited, while power is depressed. Or, after deligation of the principal artery of a limb, weakening vital power—inasmuch as collateral circulation can never be at first quite equal to the normal arterial supply—heat, friction, or other stimuli are applied; and gangrene occurs. The first is comparatively a painless process, being immediate; pain ensues only on the accession of inflammation in the adjoining living parts, whereby the line of separation is formed. The second is painful, because tedious,

and inflammatory throughout. And this it is important to remember. When we wish to get rid of a tumour, for example, or other noxious structure, not amenable to excision, we employ deligation. If we wish further, that the destructive process be both speedy and easy to the patient—as doubtless in the vast majority of cases will be our object—we do not hesitate to put him to immediate pain, by tying the ligature with as tight a strain as it will bear, so as thoroughly to cut off its arterial supply, and altogether arrest its circulation. Whereas if, unwisely, we treat him now with a gentle hand, much unnecessary pain remains for the future, the part being but partially strangulated, capable of assuming the inflammatory process, and the undergoing of that process being essential to the cure.

The most obvious illustration of this cause of gangrene, is by supposing deligation, from without. But equally efficient obstruction to arterial supply may come from within; by rupture of the principal artery or arteries; by consolidation of their canals from fibrinous deposit of a plastic kind; or by earthy degeneration of the vessels, as will afterwards be shown.

Perhaps the tendency to gangrene in inflamed unyielding textures may be caused, at least in part, by the tension, which invariably ensues, so compressing the part as either to arrest or seriously impede the already weakened circulation.

In surgical operations it is very useful to bear in mind, how sudden and effectual obstruction of both arterial influx and venous return is likely to prove fatal to the part. For instance, in performing deligation of the principal artery of a limb on account of aneurism, we will be especially careful to avoid injury to the concomitant vein; for if that be obstructed as well as the artery, gangrene of the limb—even without the intervention of undue stimulus—is extremely probable. If we can imagine the principal nerve to be at the same time seriously injured, gangrene is all but inevitable, under the three-fold evil influence of arterial and venous obstruction with deprivation of nervous agency.

8. *Cold*.—The effect may be direct or indirect; more frequently it is the latter. But direct it may be, thus. The immediate effect of cold, intense, and continuously applied to the part, is greatly to depress both its circulation and its nervous energy; and this depression, by continuance of the cause, may be carried so far as altogether to annihilate vital power. The part in truth is frozen to death; becoming cold, insensible, shrivelled, and discoloured; by and bye undergoing obvious chemical change, and becoming detached by the ordinary process of separation. This is likely to occur only in very cold climates; even then, only when the individual is exposed to hardship and privation; and the parts most liable to be so affected, are those most remote from the centre of circulation, and consequently by nature less fully endowed by vital power; and also those most habitually exposed to atmospheric inclemency—as the toes and feet, and the tips of the nose and ears.

Much more frequently the action is indirect. Cold is applied, and the lowering result follows as usual, to a greater or less extent. The

cold is suddenly removed, or very likely warmth with the additional stimulus of friction is applied, and the inevitable consequence is immaturity and excessive reaction, the blood rushing back to the part it had but lately left, with far greater impetuosity than it had before, distending every vessel to the utmost, and hurrying on the inflammatory process—and this in a part not yet recovered from the depression of vital power which the first effect of the cold had occasioned. The action is sudden and intense, power of resistance and control is low, gangrene is inevitable. It is not the patient who is simply exposed to diminished temperature, that suffers from chilblain—chronic inflammatory process in a debilitated part; or from frost-bite—the inflammation, more acute, having reached sloughing; but it is the patient who after exposure to cold, warms himself at the fire, or simply enters a heated room; or who, not contented with abstracting cold, and applying heat, adds friction to the affected part. Illustrations of this are of constant occurrence; but there is one, on a large scale, which though trite, is altogether so apposite and striking that I think it expedient, by way of corroboration, briefly to notice it here. In continuing his narrative after the battle of Eylau, Baron Larrey says—“During three or four exceedingly cold days that preceded the battle, the mercury having fallen so low as fifteen degrees below zero of Reaumur’s, and until the second day after the battle, not a soldier complained of any symptom depending on the freezing of the parts; notwithstanding they had passed three days, and a great portion of the nights of the 5th, 6th, 7th, 8th, and 9th of February, in most severe frost. The Imperial guard in particular had remained upon watch in the snow, hardly moving at all for more than twenty-four hours, yet no soldier presented himself at the Ambulance. In the night of the 9th and 10th, the temperature suddenly rose, the mercury ascending to three, four, and five degrees above zero. From this moment, many soldiers of the guard and line applied for assistance, complaining of acute pain in the feet, and of numbness, heaviness, and prickings in the extremities. The parts were severely swollen, and of an obscure red colour. In some cases, a slight redness was perceptible about the roots of the toes, and on the back of the foot. In others the toes were destitute of motion, sensibility, and warmth; being already black, and as it were dried. All the patients assured me that they had not experienced any painful sensation during the severe cold, to which they had been exposed on the night watches. It was only when the temperature had (suddenly) risen eighteen or twenty degrees, that they felt the first effects of the cold as inducing mortification.” And it is added, that those who had warmed themselves at fires suffered most.*

But cold may in a similar way cause death, not of a part, but of the whole body. General vital power is depressed; sudden reaction ensues, by the imprudent use of stimulus; and under this action the enfeebled system may succumb. To illustrate this, let us again quote from Larrey. “Woe to the man benumbed with cold.....if he entered too suddenly into a warm room, or came too near to the fire of a bivouac.....

* LARREY'S *Memoirs*, tom. iii. p. 60.

gangrene made its appearance at the very instant, and spread with such rapidity that its advances were perceptible by the eye; or the individual was suddenly suffocated with a kind of turgescence, which appeared to affect the brain and lungs; he perished as in asphyxia. Thus died the chief apothecary of the Guards.....He had scarcely been a few hours in this (warm) atmosphere, so new to him, when his limbs, in which he had lost all feeling, became considerably swelled, and he expired soon afterwards, incapable of uttering a single word.”*

9. *Animal and other Poisons*, applied to a part, by inoculation or otherwise, are usually said to be powerful excitants of gangrenous inflammation. That is they lower vital power in both part and system, at the same time exciting the inflammatory process in the vicinity of the wound. Bites of serpents act in this way; as also inoculation of putrid virus from cattle, or others of the lower animals, occasioning the “malignant pustule;” and, much in the same way, there is no more certain cause of rapid and extensive gangrene, with most serious results to the system, than by the infiltration of urine into cellular tissue.

Hitherto we have considered chiefly such causes as are local and external; we now come to those which are constitutional and internal.

10. *General debility*, from any cause—hemorrhage, starvation, age, persistent disease, or long continuance of any generally depressing agent—predisposes both to the accession of perverted vascular action, and to its untoward advance; there being but little power, either in part or system, for resistance or control. Or vital power may be so far diminished, especially in those parts naturally the weakest, being most removed from the centre of circulation, as to cause death in a more direct way, without the intervention of inflammatory action; simply by mal-nutrition, and gradual failure of vitality in consequence. This latter mode is not unfrequently exemplified by simple gangrene of the toes after exhausting fever.

A peculiar disorder of the system, certainly not of the purely sthenic type, attends on the internal use of mercury, carried to sustained ptyalism. This seems very favourable to the assumption of the inflammatory process, and to the invasion of sloughing, as well as of fierce ulceration, during its progress; a fact abundantly exemplified by the frequent occurrence of sloughing and phagedæna, in an aggravated form, in venereal patients recklessly salivated.

11. *Improper food*, habitually taken, leads to disorder of the system of a feeble type, and thus will at least predispose to gangrene. But one poisonous article of diet, in particular, causes a constitutional disorder of a very aggravated character, an almost invariable result of which is chronic and dry mortification of the extremities. The article alluded to is an unsound kind of rye, not uncommon in the north of Europe. A black curved excrescence, not unlike the spur of a fowl, grows on the spike, and sometimes is found in such quantities as to form nearly one-fourth of the produce of the rye; it is termed the ergot of rye, or *secale cornutum*. Its habitual use as food induces lassitude, weakness of the extremities, a feeling of intoxication, and periodic

* *Op. Cit.* tom. iv. p. 134.

convulsive movements. This state, called raphania, may continue for days or months. And frequently, during its persistence, mortification of the extremities occurs, beginning in the toes and gradually extending up the leg, attended with but little pain, and without appreciable precursory inflammation; the part becoming at once cold, insensible, and discoloured, and gradually dry, hard, and shrivelled. In some of the recorded cases, the line of demarcation formed, separation was completed, and recovery took place; in the majority, however, the disease advanced unchecked in either its constitutional or local form, and the issue was fatal. In this country, a somewhat similar malady has been traced to the use of unsound wheat.

12. *Atmospheric influence* acts favourably or otherwise on the system, more especially of the invalid. When a deleterious impression has resulted, no uncommon indication of this is the appearance of sloughing in a previously healthy wound or sore. To such a cause, for example, the invasion of hospital gangrene is perhaps most frequently attributable.

13. *Arterial degeneration*.—In advanced years, the whole arterial system, but more especially the ramifications in the lower extremities, are liable to degenerate, by deposit of calcareous matter between the coats, to a greater or less extent; sometimes converting them into completely rigid, and as if altogether ossified tubes. This of itself may exist so generally, and in so advanced a form, as ultimately to render effectual circulation through such altered conduits impracticable; and circulation gradually ceasing, so does life; death of the part ensues, a gradual and painless process. Or, ere the change has advanced so far as to cause complete arrest of circulation, but quite far enough sadly to enfeeble vital power, a low perverted action may be kindled by some of the many exciting causes to which the part is liable; and low though such action be, it is usually sufficient to cause more or less extensive gangrene, for it invades a part whose power of resistance and control has been much impaired.

Again; it has been supposed by some that perverted action is very liable to occur in the vessels themselves when so changed; and as an invariable result of arteritis is known to be consolidation of the arterial contents, with consequent occlusion of the canal, and arrest of circulation—this occurring generally in a limb would be certain to induce its death. By Dupuytren it was imagined that the greater number of cases were thus to be accounted for. But, without denying the possibility of the occurrence, or that it does sometimes so cause mortification in the aged, it seems more reasonable to believe that the painful and inflammatory form of this disease is attributable to that action having invaded not the arterial tissue alone, but the whole part.

Thus we find the old man peculiarly exposed to mortification, particularly in the parts naturally most weak—the feet and toes. To such mortification, usually gradual, chronic, and dry, the term *Gangrena senilis* is commonly applied. This disease, however, is not to be considered as invariably occurring in one way, and consequently in all cases amenable to one and the same mode of treatment, otherwise much practical evil must result; indeed, there is good reason to believe, that

from this very circumstance, not a few lives have been hurriedly disposed of, which otherwise might have been long protracted.

The senile gangrene varies in its nature. 1. It is not necessarily attended by arterial degeneration. And when not so accompanied, but induced by simple general debility, incidental to advanced years, and perhaps aggravated by casualties to which every age is liable—it may occur with or without the intervention of inflammation. Circulation and vital power may gradually cease; or the latter is overborne by accession of perverted vascular action. 2. Likewise, when calcareous degeneration does exist, there is a similar alternative of events; the death may be inflammatory or not; acutely painful, or comparatively painless.

In practice, perhaps the most important division of this form of mortification is into that which is preceded and accompanied with perverted vascular action, and that which is not; for to the variety of cause, ought the mode of treatment to be accommodated.

The accompanying inflammation is always of rather a low type, the part of enfeebled power being not only easily overcome by such, but being really incapable of assuming an action of high intensity; in consequence, the term of *inflammatio debilis* is often applied.

Or the inflammatory and non-inflammatory forms may be blended. The latter may seize on one or more toes, converting them simply and quietly into black and shrivelled eschars; and, after a time, the mortification ceases to extend upwards. As usual, an effort is then made by Nature to throw off the dead and noxious parts; and this we know can be effected only in one way, by inflammation and ulceration. The action is accordingly assumed at the living margin; and heat, redness, swelling, pain, appear there. But the part has no sufficient power of control; the desired result of ulceration and suppuration is quickly overpassed, and mortification ensues. The inflammatory has become engrafted on the simple form, and proceeds rapidly, with much pain and constitutional disturbance. It would seem as if the effort, by vascular action, towards arrest and separation were being constantly made, and never with success; on the contrary accelerating the destructive progress.

Thus then we may have senile gangrene, throughout unattended with pain, redness, swelling, or other signs of the inflammatory process—excepting, ultimately, the line of separation. Or from the beginning these are present, and continue, until either arrest of the disease or death of the patient ensue. Or the pain, heat, and redness, though at first absent, may supervene; and then continue of an aggravated character.

The disease is most liable to occur in males, of the higher ranks, and who have indulged freely and habitually in the pleasures of the table—all the more likely if organic disease of the heart or aortic valves be present. And the most frequent form, is that which is attended by the *inflammatio debilis*. The original description by Mr. Pott merits quotation. He calls it “that particular kind of mortification, which, beginning at the extremity of one or more of the small toes, does, in

more or less time, pass on to the foot and ankle, and sometimes to a part of the leg; and, in spite of all the aid of physic and surgery, most commonly destroys the patient." Usually "the patients feel great uneasiness through the whole foot and joint of the ankle, particularly in the night, even before these parts show any mark of distemper, or before there is any other than a small discoloured spot on the end of one of the little toes. It generally makes its first appearance on the inside, or at the extremity of one of the smaller toes, by a small, black, or bluish spot: from this spot the cuticle is always found to be detached, and the skin under it to be of a dark red colour. Its progress in different subjects, and under different circumstances, is different; in some it is slow and long in passing from toe to toe, and from thence to the foot and ankle; in others its progress is rapid, and horribly painful. It generally begins on the inside of each small toe, before it is visible either on its under or upper part; and when it makes its attack on the foot, the upper part of it first shows its distempered state, by tumefaction, change of colour, and sometimes by vesication; but wherever it is, one of the first marks of it is a separation or detachment of the cuticle."—The constitutional symptoms are such as characterize gangrene in general; that is, constitutional irritation, tending towards typhoid collapse; but chronic in its nature, like the local action; and pain, restlessness, and hiccup—especially the two former—are particularly prominent. In the non-inflammatory form, the constitutional disorder is often very slight, at least during the commencement of the gangrene.

The *Progress* of mortification is sometimes slow, making but little advance in days and even weeks—as in the senile and other chronic forms. Sometimes it is fearfully rapid, as in the acute and traumatic, spreading within a few hours over a whole limb.

When arrest has occurred, Nature begins her process of *separation*, as formerly described. A sthenic form of inflammation is established in the living margin; suppuration and ulceration supervene; and this destructive action is in its turn followed by granulation, and effort towards repair. At the same time the symptoms of constitutional irritation gradually subside, and a sthenic and normal state of system is gradually restored.

The *Prognosis* varies according to the extent of the mortification, the nature of the part in which it has occurred, and the condition of the system during and before its accession. The larger the gangrened part, the more important it is as a part of the general economy, and the lower the constitutional powers, the greater the danger to life; and *vice versa*.

Treatment of Mortification.

The treatment of mortification in general resolves itself into five principal indications. Remove or mitigate the cause; wait for the

line of demarcation ; assist Nature in her efforts towards detachment ; promote and regulate the healing process ; and maintain due power of system throughout invasion, arrest, and cure.

But in the first place let diagnosis be accurate ; be sure that it is a case of gangrene. In mere bruise there is discolouration of a livid hue, and dark-coloured serous vesicles form somewhat resembling phlyctenæ ; but the points of difference, formerly noticed, are sufficiently plain. And it is well that such is the case, inasmuch as error of diagnosis would infallibly lead to serious error of practice. On undoing a fractured limb, for example, after the first application of retentive apparatus, it is not uncommon to find it swollen, darkly discoloured, and studded by dark vesications. If this be gangrene, amputation, at some distance above the parts so affected cannot be too soon performed. If it be but the effects of bruise, fomentation, mild antiphlogistics, and gentle re-application of the retentive means, are all that the circumstances demand.

In the inflammatory form, removal of the cause is to be attempted by antiphlogistics. And, prevention being better than cure, it will of course be advisable to have recourse to these early and efficiently, to arrest the inflammation's progress timeously, and save the vitality of the part. But let not the chance of immunity from gangrene be purchased at too high a cost. Copious general blood-letting, with other spoliative and depressing remedies, may make much impression on the inflammatory action, and so at least limit the occurrence of gangrene at the time ; but the process of separation of the dead parts, followed by attempts at repair, has to come, with its exhausting discharge ; the powers of the system are certain to be severely tried ; and if they have been at the outset imprudently exhausted, they cannot fail to sink when they are most required. Besides, the bleeding may not even secure the temporary benefit ; on the contrary, general and local power may be so weakened thereby, as to render them an easy prey to the action even in a subdued form. It is often that antiphlogistics are thus used with a blind and rash improvidence ; the cure is protracted and embarrassed ; the system is enfeebled, and perhaps for ever broken ; or even the issue may be fatal. Cases of threatened gangrene after severe bruise, laceration, fracture, &c., afford abundant illustration of this practical point. The ulterior result must always be regarded, along with the present ; and both provided for. We are to prevent or limit gangrene, if we can ; yet wielding antiphlogistics so as to make sure of leaving power enough of system, for defence from hectic and exhaustion during the suppurative stage.

Also let it be borne in mind, that it is only before and at the very commencement of the gangrene, that antiphlogistics can ever be actively employed. When mortification has been fairly established, the symptoms change, and require a corresponding alteration of treatment ; inflammatory fever, sthenic, is superseded by the asthenic constitutional irritation. And further ; when gangrene is both certain to occur, and to prove extensive, the class of symptoms corresponding to that result are often fore-shadowed in the characters of the preceding action, both locally and generally ; modifying these in so marked a manner, as

at once to enlighten the experienced practitioner as to the impending issue. Such a state, not unfrequently connected with a previously debilitated power of system, is often, and not inappropriately, termed the gangrenous inflammation; and in this, antiphlogistics, at however early a period employed, must invariably be used with the greatest caution and forbearance. On the other hand, if the inflammation be intense, limited, seated in an important part, with both local and general symptoms plainly sthenic in character, and occurring in a robust unbroken frame—we bleed copiously and fearlessly, employing also the other suitable antiphlogistics with energy. For, in these circumstances, such are the only true preventives of gangrene.

But constitutional remedies, foolishly held as specifics, and termed *antiseptics*, were at one time much in vogue, and may not yet have fallen altogether into desuetude. Of these the most prominent was bark, given in full doses. The exhibition of this at an early period, will plainly aggravate the disorder—offend the stomach, increase the inflammatory fever, influence the local action unfavourably, and render the gangrene both more speedy and more extensive than it otherwise might have been. It can only be of use, as other tonics, after the period of excitement has gone by; limiting or preventing hectic, and assisting the system to bear up under the exhausting influence of supuration.

Previous to gangrene by inflammation, then, antiphlogistics are expedient; early, active, yet cautious; invariably controlled by regard to the impending future; their object is to prevent local death if possible, and yet not seriously impair general power. When gangrene has occurred, they may be continued, in sthenic cases, but now with still more subdued caution; to limit the mortification as much as possible, but still without injury to the system. When, however, the constitutional symptoms of gangrene are fully developed, of their usual type, antiphlogistics are wholly unsuitable; the disorder has passed from inflammatory fever into a grave form of constitutional irritation tending to collapse; and calmatives, support, tonics, stimuli, will probably be required. Opium, in full doses, and pretty frequently repeated, is an admirable remedy at this stage; calming the general system, blunting the sensation of pain and illness, and seeming to impart a power of tolerance to the frame under the depressing agency of the gangrene. At the same time more or less stimulus is usually required; and the preferable forms are the alcoholic and ammonia; administered with the cautions formerly explained. Hiccup, it will be remembered, was spoken of as particularly troublesome in many cases; if it do not yield to the general treatment, musk, camphor, ammonia, may be employed as special correctives. When the gangrene has ceased, and separation been commenced, usually the general symptoms again change towards the sthenic form; and in consequence, a guarded and somewhat antiphlogistic regimen will probably be expedient, lest the action necessary for detachment should prove excessive, and reinduce sloughing; but, on the contrary, should both general and local appearances betoken debility, cautious support by nourishing food, and the more simple tonics, must be maintained. When detachment has been completed, we have then

to do with a simple sore—inflamed, ulcerating, granulating; weak, irritable, or healthy, as the case may be—and the ordinary treatment is to be conducted accordingly.

If a palpable exciting cause appear—as deligation, obstructing venous or arterial circulation, or both—that of course must be instantly removed. Infiltration of poisonous or acrid fluid will be got rid of, or limited in its effects, by free incision. Noxious atmospheric influence must be either changed, or neutralized as far as possible. If sloughing be from compression, the pressure must be removed or modified; if from bad food, diet must be amended; if from mere general debility, that must be obviated by a suitable support.

Mortification by *Pressure* very frequently engages the attention of the practitioner; commonly as the result of long confinement to the recumbent posture; sometimes by inaccurate or injudicious adjustment of retentive apparatus in the treatment of fracture. When sloughing by such causes has been induced, it proves a source of much inconvenience to both patient and surgeon, as can be readily understood. It is to be avoided by care in subdividing the pressure among many points, preventing its concentration and maintenance on one or two alone. In fracture of the leg, for example, the retentive means will be so arranged as to compress not solely the malleoli or the heel, but to be equally borne by the whole surface of the bandaged limb; and such precautions are especially desirable in the case of the aged and weak. When bed-sores are threatened, the points naturally most compressed—over the sacrum, trochanters, heels, scapulæ, elbows—must be relieved as much as possible, by frequent variation of posture, by the adjustment of pads or pillows on the adjacent parts, and if possible by the use of that admirable contrivance for such purposes, the hydrostatic bed, by which the labour of support is equally distributed on every part of the surface. The reddened and painful parts—for it is usually by inflammation the part perishes, power being seldom so very small or pressure so great as to occasion immediate and direct death—are to be pencilled over by nitrate of silver, either in substance or in solution, so as merely to blacken the integument, carefully avoiding the vesicating effect; our object being simply to resolve the inflammatory process. At the same time, of course, our utmost efforts will be directed towards the general recovery of the patient, in order that recumbency may be disused. When breach of surface has ensued, it early assumes the weak characters, requiring stimulating applications accordingly.

When *mechanical or chemical injury* is the cause, we have seldom the power of altogether preventing mortification; limitation is our object. So soon as the first shock has passed over, our treatment is antiphlogistic; in order that death may be confined to those parts which suffer directly from the injury; saving those which have their vital power less diminished, and which might contrive to live if let alone, but which would be unable to combat brisk inflammation successfully. A certain amount of inflammation must ensue; but we are anxious to limit that to what is merely necessary to effect detachment of the original slough. During the progress of detachment, the antiphlogistic regimen will be probably expedient; thereafter, by improved diet, and other tonic

means if necessary, the general power is to be maintained, sufficient to ward off hectic and duly carry forward the operation of repair.

In the case of mortification from *Cold*, it is our duty to prevent the occurrence if possible; and as, in this climate, it is seldom that the destructive result is by the direct effect, but by the secondary or reactive, such prevention is not unfrequently within our power. Plainly, it is to be effected by moderating reaction; abstracting cold, and yet not applying sudden heat or other stimuli. The common practice is very successful, and though perhaps not actually based on scientific principles, can be most satisfactorily explained by them. A part undergoing the freezing process—threatening to die by the direct effect of intense cold—becoming pale, shrunk, and but little sensible, is rubbed with snow, while the patient and part are yet in the open air, or at least not exposed to sudden elevation of temperature. The rubbing arrests the sedative effect, and induces reaction; but rubbing with cold ensures the reaction being gradual, slow, and safe; circulation and nervous influence are restored; and this returning vital power, finding no undue action to oppose or control, reigns paramount.

When gangrene has set in, by reaction proving excessive, our object is to moderate this, and at the same time sustain constitutional power; poultice, water-dressing, pencilling by nitrate of silver, or other soothing applications locally; careful regulation of diet, and administration of suitable remedies internally—at first moderately antiphlogistic, then opposed to constitutional irritation. On separation of the sloughs, the customary treatment is adopted.

In the chronic gangrene of old people, the *Gangrena senilis*, we may have two distinct forms as already shown; death, direct, from mere want of power; or death indirect, weakened power being overcome by inflammatory action. In the former case, cautious general support is expedient, enough to maintain and increase general power; yet cautious to avoid the induction of an inflammatory process, which we know the part to be unable to bear; and the part itself may be covered over with tepid water-dressing, or any other bland protective application.

In the second, or inflammatory form—much the more frequent—our object should be to subdue the local or perverted action, yet without impairing, on the contrary rather adding to, the general power of system. The best local application with this view, is the nitrate of silver, pencilled over the red, painful, and swollen parts, so as merely to blacken, and obtain the simply sedative and antiphlogistic result; covering the part afterwards with a light soft poultice, or water-dressing. The patient should be kept in the recumbent posture, with the part somewhat elevated. The diet must be non-stimulant, otherwise action, already beyond the power of the part to bear, will be further increased; it must yet be not truly antiphlogistic, or starving, otherwise both general and local power, already weak, will be still further impaired, and the existing action, even without increase, rendered more and more destructive. It will consist, then, of simple farinaceous food; such as will maintain power, and yet not favour undue vascular action. At the same time the continued use of opiates is highly expedient. Great pain and general irritation attend the progress of the disorder. The former is in part

alleviated by the nitrate of silver; both will be much assuaged by opium, which further, according to some, would seem to exert a beneficial tonic effect on the capillaries, thereby tending to increase vital power under circumstances when it is much required. Under such treatment, we expect, and often not in vain, pain, redness, and swelling to cease, as also the advance of the mortification; a healthy line of demarcation is established; the dead parts are thrown off; the patient rallies greatly in his system; and in short recovery is obtained, though not of course without more or less mutilation.

But such was not the practice, and such were not the results of former times. The practitioner took but a one-sided view of the case; regarding deficient power alone, and overlooking redundant action. His patient was literally crammed with diet of the most rich and stimulant kind; if in the better ranks of life, his table was made to groan daily, as well as himself, under the most sumptuous viands; and yet the generous food seemed only to feed the disease, not the patient. The dusky redness spread more and more, and both part and frame sank under it. The error was at length perceived, and an opposite extreme was gone into. Seeing then nothing but over-action, antiphlogistics were had recourse to, as if the process were of the ordinary sthenic form; disregarding the want of power, which did not fail to increase under the neglect. Dupuytren, for example, trusted to venesection. Now, a middle place is wisely selected; we neither stimulate nor spoliolate the system; local action is moderated, while both local and general power is enhanced and maintained; and the result is altogether satisfactory.

Local Applications in mortification.—Local as well as general antiseptics were at one time believed in; and were of an alcoholic, terebenthinate, or otherwise stimulating nature. If employed previously to the accession of gangrene, while inflammation is still in progress, they invariably prove injurious by hurrying on that action, already excessive. During progress of gangrene towards sphacelus, all stimulation of the part must still be prejudicial, for a like reason. When sphacelus is complete, the stimulants acting on the surrounding living parts, which are being sthenically inflamed for the purpose of effecting detachment, are likely to aggravate such action to an injurious extent. As to their effect on the dead parts themselves, it is either nugatory, or the reverse of beneficial. For, however useful spirits of wine or turpentine may be in preserving parts already detached from the system, similar preservation is certainly not what we desiderate during the process of separation; on the contrary, sloughs cannot be too soon removed from the living tissues. Local stimulants, therefore, improperly named antiseptics, are not only useless, but hurtful.

Scarifications were also at one time in vogue; usually with the view of enabling the antiseptics to prove more effectual. If they merely implicated the dead parts, they were inefficient. If they penetrated these, and reached the living and inflaming stratum beneath, they obviously did harm, as undue stimulants. Under only two circumstances are incisions likely to prove beneficial in gangrene. First; when suppuration

has freely occurred beneath a separating eschar, which, being marginally adherent, and itself incapable of the ulcerative process, induces all the evils of tension and pressure on an acutely enlarging abscess; incision through the eschar, under such circumstances, will afford infinite relief—and it is not unfrequently thus required in cases of burn. Second; when by free incision we may remove the cause of gangrenous disaster, past, present, and impending; as in phlegmonous erysipelas; and in diffuse cellular infiltration, whether of a purulent or urinous kind.

During the formation and separation of the sloughs, light poultice or warm water-dressing are the preferable applications; as soothing, grateful, and protective to the living parts. Often the latter may be advantageously medicated, by solutions of the chlorides of lime or soda; at first chiefly applied to the dead parts, as correctives of fœtor; afterwards used, not only with this view, but as a suitably stimulant lotion for maintaining reparative energy in the living ulcer.

As the sloughs become detached, by the undermining process of ulceration in the living stratum, they should be removed; such removal tending to diminish fœtor, and the risk to the system by absorption of the results of putrescence. If necessary, scissors are employed; cutting with these only in the dead part however; for, in affording assistance to Nature in her detaching efforts, we should occasion neither one moment's pain, nor the loss of a single drop of blood. Pulling rudely at yet adherent sloughs, or cutting in living parts, is not unlikely to re-induce the sloughing action; more especially when the gangrene is of the chronic form, and attended with general debility. After separation, both part and system are treated as in ordinary granulation; only with a fore-knowledge that, on account of previous exhaustion, support will be soon demanded on the part of both.

The nitrate of silver we have seen to be very useful as an opponent of the *inflammatio debilis*, in chronic gangrene. By some it has been employed with another object in view; during advancing gangrene; applied intensely, to the sound part, so as to produce vesication, inflammation, and ulceration; instituting, as it were, a fictitious line of demarcation; and attempting to dictate to Nature as to the point of arrest. It need scarcely be said that the result has disappointed the expectation. Nature is not thus to be schooled. Inflammation was doubtless excited, but not of the *sthenic* type, which alone can give the ulcerative sulcus of separation; but still of the *asthenic* and excessive kind, courting and hastening progress of the mortification.

Question of Amputation.

1. Amputation is not unfrequently advisable, in order to *prevent* the occurrence of gangrene. Thus; when a limb has been much injured by mechanical or chemical injury—a severe compound fracture or burn, for example—and it is apparent to the experienced observer that mortification must ensue, involving the whole thickness of the limb, acute, tending to spread, and from the first accompanied by the most formida-

ble constitutional symptoms, amputation is performed above the injured point; so soon as the primary shock has passed away, and the system rallied so far as to afford sufficient tolerance of the operation.

2. When after such injuries gangrene has set in, of the acute and spreading kind, there is now no question as to the propriety of immediate operation. At one time, it was by many considered right, in this and in all other cases of mortification, to wait for the spontaneous line of separation. But delay, under these circumstances, with such an object in view, will be in vain. The gangrene spreads upwards and upwards, with a diffused and streaky margin; the typhoid symptoms grow more and more intense; the trunk is reached, rendering operative interference hopeless; or, long ere this, the system has sunk, and the patient perished. The only hope of escape, is by early amputation; it is a slender chance—for the probability is that the sinking may continue, or even the gangrene be resumed—but it is the only one, and to it the patient is entitled. While the mortification is spreading, then, we amputate at a distance from the gangrened part, in one which is sound, or at least appears to be so. If there be no point, distal to the trunk, altogether free from the signs of incipient death, we refrain from the knife; its use must then prove futile, and would but accelerate the fatal issue. And in making selection of the line of incision, when amputation is advisable, it is well to remember that the subcutaneous cellular tissue is often an earlier victim to the gangrene than the skin itself; that therefore a point in the immediate vicinity of the discoloured margin is never suitable; and that in all cases careful manipulation should be employed to ascertain, if possible, that all textures, as well as the skin, are yet sound; otherwise we might be cutting in parts not only doomed but dead. Sometimes a case presents itself of acute traumatic gangrene, in which there is yet even much space apparently suitable for amputation, but in which the constitutional depression has advanced so far as to render the shock of an operation then performed certainly fatal. In such circumstances our attention must be mainly directed to rousing the vital powers, sustaining them under the depressing agency; and if, thus aided, they fail in attaining to even a temporary ascendancy, we refrain from operation.

3. In the chronic form of gangrene, arising without apparent external cause, there is no such haste in the use of the knife. Nature's initiative is calmly awaited. For until the line of separation has been formed, we cannot know how far the gangrenous conspiracy between action and power has extended. If we amputate during progress, it is most likely that we shall be cutting in parts fore-doomed; they had not power enough to resist the *inflammatio debilis*, which was gradually creeping on, and certainly will not for an instant withstand the graver amount of action which such formidable incisions must certainly excite. And, further; even after the line of separation has occurred and is duly advancing, it is probable that, local as well as general debility being still great, the parts have just power enough to sustain the spontaneous inflammation necessary for the ulcerative process, and would fall below the stimulus of incision. Therefore, we wait not only until the line of demarcation has been made, and separation begun; but until the latter

has been in a great measure completed; assisting Nature's amputation, rather than operating ourselves; using our knife and saw merely to divide the fibrous and osseous textures, which are slow to ulcerate in this way; injuring the living parts as little as possible; yet sloping the knife upwards, in order to have an opportunity of sawing the bone so high as to afford a fair prospect of the stump proving sufficiently fleshy and useful. In such cases, the system is very intolerant of loss of blood, and that is another reason why incisions should be so guarded. There is a circumstance, however, attendant on the disease, very favourable in this point of view. The dry, hard, impenetrable sphacelus, has the same effect on the arterial tubes on its cardiac aspect as a ligature; a remora of their circulation is induced, coagulation takes place, and each arterial canal is obstructed up to the nearest open collateral branch. As the line of separation passes through, the canals are further and more securely shut up by fibrinous effusion—such ulceration being of the sthenic kind, and as usual preceded and accompanied by plastic exudation. Even supposing, therefore, that our knife does encroach a little on the living parts, higher than the line of spontaneous ulceration, the hemorrhage is likely to prove but very trifling.

4. In the chronic gangrene which is induced by cold—an obvious external cause, and independent of constitutional vice or failing—we still await the line of demarcation; for otherwise we cannot tell how far the fatal amount of local depression has extended. But after separation has been fairly and spontaneously begun, we do not hesitate to amputate; and with the option of either finishing Nature's operation just commenced, or of cutting in a higher and perhaps more suitable situation. For, the debility being only local, temporary, and not dependent on organic change, the occurrence of the line of separation is sufficient evidence that in every point of the living parts there is then tolerance of operation. Usually a better stump can be fashioned at a higher point than that which Nature has happened to select. But were such amputation to be made previous to arrest of the gangrene, most probably the flaps would speedily slough.

Thus then, when gangrene is acute and humid, dependent on an external cause, and unconnected with a previously existing failing of system or organic change in the general limb, we amputate, if at all, during the progress of the disease, without waiting for a line of demarcation. When it is chronic and dry, dependent on an internal cause only, or on internal more than on external causes, and connected with failing of both general and local vital power, we wait for the line of demarcation, watch the progress of separation—cautiously supporting the system meanwhile—and when detachment is far advanced, we interfere merely to facilitate and modify its completion; we amputate in the line of separation. When gangrene is the result of one particular external cause, cold, we await the line of demarcation; and so soon as that has been fairly formed, we amputate either there, or above, according as circumstances may seem to require.

SECTION II.

PERVERTED VASCULAR ACTION IN CERTAIN TISSUES.

CHAPTER VII.

PERVERTED VASCULAR ACTION IN THE INTEGUMENT.

Erythema.

By this term is meant perverted vascular action, of a low grade, and tending to spread by continuity; occurring in the mere surface of the integument; chiefly resident in the rete vasculosum cutis; and seldom if ever rising beyond the stage of active congestion.

The *symptoms* are heat, pain, and tingling in the part; a bright red blush, sometimes marked by an abrupt and distinct border, sometimes gradually lost by diffusion; more or less dryness, by interruption to normal exhalation; a very slight tumescence of the red surface, scarcely appreciable by the eye, yet capable of being distinctly felt by the finger lightly applied; increase in susceptibility of external impressions in general; and tenderness on pressure, which produces transient whiteness, and very slight as well as temporary depression. These symptoms having continued for a day or two, may simply decline; the part becoming gradually less swollen, red, tender, and painful, and resuming its wonted function; numerous scales of cuticle become detached, and fall away; and the result is usually termed Resolution by desquamation. Or, less frequently, vesication occurs; the vesicles forming slowly, and to no great extent; filled with a watery straw-coloured serum; either simply drying, or bursting and then crusting over; the uneasy feelings thereafter gradually subsiding; and desquamation again constituting the last part of the process of cure. The constitutional symptoms may precede or accompany; sometimes they are sthenic, and of the inflammatory type, slight and transient—the consequence of the local disorder; sometimes they are of the form of constitutional irritation, preceding rather than accompanying, and oftener the cause than the effect of the local ailment.

The *cause* may be either local or constitutional, external or internal. Often it is external and local; a puncture of the finger for example in dissecting, nursing, washing, probably with a state of system not ill-disposed towards the assumption of morbid action. The injured part undergoes the inflammatory process; and this, instead of remaining of a circumscribed character, spreads by continuity. The constitutional

disorder is then of secondary occurrence, slight, of the inflammatory type, and soon passes away.

Or the cause may be internal and constitutional. The *primæ viæ* are sadly disordered; there is much bilious derangement, and serious febrile disturbance; during the progress of this febrile condition, an erythema breaks out on some part of the surface, spreading more or less; and on its appearance the general disorder undergoes a marked diminution; it is, as it were, an example of Nature's mode of relief by counter-irritation and derivation. Or the parent is labouring under a low typhoid fever, and during its progress an erythema forms; sometimes with relief—though not so marked as in the former example—sometimes seeming rather to embarrass the system still more, and increase the tendency to prostration.

The *treatment* varies according as the erythema is reckoned the disease itself; or only as a symptom of another, far more important. If the cause be local and external, with constitutional disorder slight and secondary, treatment is direct, as for the disease. The part is kept at rest, and fomented; or is lightly pencilled over either with a solution of iodine, or with the nitrate of silver, either solid or in solution—the latter probably the preferable application; seeking only the first effect, blackening and non-vesicant, simply antiphlogistic. Antiphlogistic regimen is enjoined, a purge administered, and perhaps a little antimony. Resolution is obtained.

If however the cause be internal and constitutional, with the general symptoms formidable, and antecedent as well as concomitant, we seek not resolution. As small-pox and scarlatina have their eruptions, are relieved thereby, and become much aggravated by their repulsion, so fevers—simple, bilious, typhoid—sometimes have theirs, of an erythematous character; and the use of repellents is not more foolish in the one case than in the other. Our principal attention will be directed to the general disorder, contenting ourselves with palliation of the local; occasional fomentation relieves the unpleasant feelings in the part, and at the same time rather encourages the derivation than otherwise.

When we are especially desirous that a spreading erythema shall be turned aside from certain parts, the nitrate of silver, still used lightly, is of service; not applied to the erythematous part, but in its vicinity; not as a resolute, but as a limiting agent.

Erysipelas.

Erysipelas denotes the inflammatory process, seated in the skin, and sometimes in the subcutaneous cellular tissue as well; prone to spread, and tending to the true inflammatory crisis. According to its seat, cause, and general characters, the action exhibits marked variety in the symptoms and results; and various forms are in consequence enumerated. We shall treat of the simple, phlegmonous, œdematous, bilious, and erratic.

1. *The Simple, or Cutaneous.*—The morbid action pervades the entire true skin; and is more progressive than in erythema. The ordinary symptoms, therefore, of such action, are more prominently deve-

loped. The redness is greater; often of a rosy hue, and hence the vulgar name of the disease; the swelling is greater, appreciable by both sight and touch; the heat and pain are of a burning kind, and often intense; pale dimples by compression are more distinct and less transient—though still soon passing away, by reflux of both circulating blood and extravascular serous effusion. At first, there is no actual tension; the swelling is slight, gradual, serous, and soft. Sometimes, however, when the action is especially acute—the case perhaps threatening to pass into the second form of the disease—swelling is fibrinous, considerable, and rapid; and more or less tension occurs. Ordinarily, as the moderate action steadily progresses, serous effusion takes place superficially, elevating the cuticle by vesication; sometimes extensive and continuous, sometimes in the form of numerous small vesicles. On the cuticle giving way, spontaneously or by puncture, the serous fluid escapes, usually with relief to the symptoms. But not unfrequently a similar effusion occurs on the internal as well as on the external aspect of the cutis; serum is infiltrated into the subcutaneous cellular tissue, which, though originally free, now becomes involved in the morbid process; and if the effusion be both copious and rapid, the swelling becomes tense as well as much increased, and the symptoms are aggravated thereby.

Very generally a strong tendency is evinced by the mucous membranes, both of the respiratory and alimentary systems, to sympathize with the cutaneous surface; and not unfrequently, they seem to undergo, simultaneously, a somewhat similar affection—and this without metastasis.

Like erythema, erysipelas may simply resolve. Or vesication occurs, either alone, or along with gradual subcutaneous effusion; the vesicles burst, or are artificially emptied, the subcutaneous effusion is absorbed, the symptoms abate, and the part quickly regains its normal state, by a process which may be still termed Resolution—by vesication. Such recovery is not always uniform and general; it may be partial and successive; the part first attacked becoming first restored, while that more recently involved, in the line of extension, is yet in the nascent and acute stage. Sometimes, however, the action does not recede though vesication occur. The vesicle bursts, and the serum is discharged, but simple desiccation does not follow. A purulent discharge appears; for the action has advanced to the grade of true inflammation. And not improbably a similar formation may occur on the internal aspect as well, either at the same time or subsequently; causing subcutaneous abscess. Such abscess only forms in the more intense or neglected cases of simple erysipelas; it is neither early nor diffuse as in the phlegmonous form, but surrounded by the usual fibrinous deposit, and consequently amenable to the ordinary treatment. Should incision be delayed, however, sloughing of integument is not unlikely to follow; for the cellular tissue, having been previously infiltrated by acutely effused serum, readily yields before the suppuration, so far as the limiting fibrinous deposit permits; the skin is early undermined, and, being itself inflamed, with difficulty retains its vitality.

But suppuration, in simple erysipelas, is usually still more secondary.

After the ordinary symptoms have satisfactorily subsided, and almost disappeared from the general surface affected, it is not uncommon to find, in those especially of feeble constitution, that inflammatory reaccession of a more intense and circumscribed character has occurred at one or more points of the part originally attacked; in erysipelas of the face, for instance, the lower eyelids often thus suffer. The returned action is acute; the part newly and imperfectly recovered from a previous inflammatory process, is vitally weak; in consequence, suppuration is early and copious; in the course of but a few hours a considerable abscess may have formed. And it is under such circumstances that sloughing of the integument is most especially probable, if the evacuating incision be delayed.

The ordinary *cause* of simple erysipelas is external injury, often slight, applied during a disordered state of system, favourable to inflammatory accession. In most cases, therefore, the constitutional symptoms may be said to precede the local; but the antecedent are not inflammatory; they are either simply febrile, or, more frequently, those of stomachic and biliary derangement; foul tongue, bitter taste in the mouth, head-ach, tendency to shiver, thick turbid urine, sickness and bilious vomiting, &c. On the occurrence of the local action, the general disorder, as usual, assumes more or less of the inflammatory type; then gradually subsiding, as both local action and its constitutional predisposing cause yield to suitable treatment. When the local action is comparatively slight, the antecedent constitutional disorder is often relieved by its appearance, and can scarcely be said at all to acquire the inflammatory type.

In some cases the cause would seem to be purely local. Then there are no precursory general symptoms; the constitutional disorder is secondary, and of the ordinary inflammatory character. The light and gentle modern treatment of wounds is beneficial, as opposed to inflammation, not only in favouring speedy reunion, but also by avoiding the risk of such inflammation assuming the spreading or erysipelatous character.

Often the state of the atmosphere seems to exert a powerful predisposing influence in favour of the accession of erysipelas; and hence we not unfrequently find the disease assuming an epidemic form, during spring and autumn, when atmospheric vicissitudes most prevail. When such is the case, we also find the constitutional symptoms, whether primary or secondary, tending to show more or less of the asthenic character; the more especially as the majority of those attacked are of already weakened frames, by dissipation, poverty, or previous disease.

Habitual exposure to heat, as in cooks, and furnace-men, predisposes to erysipelas, by occasioning frequent sanguineous determination to the surface. And frequent irritation of the skin, by friction or otherwise, has a similar effect; as in sailors, by the rubbing of hard canvass trousers, often saturated with the briny element of their vocation. Exposure to cold, by its reactive effect, may predispose to erysipelas, in those parts chiefly implicated—the hands and face; as in coachmen. But it is to be remembered, that in such cases, as well as in those of habitual exposure to heat, other causes are in operation, especially in the lower ranks; namely, habits of intemperance.

When erysipelas has once occurred, both part and patient remain

liable to its return, from the application of a comparatively slight cause ; and are to be guarded accordingly. Many persons, particularly females, are the subjects of regular periodical attacks, usually slight ; but though very amenable to the usual treatment, these are not to be rashly interfered with ; their occurrence and ordinary course seeming to be a natural relief from more serious impending disorder of the system.

Prognosis varies according to circumstances. The more extensive the erysipelas, the more grave are the constitutional symptoms, and the more serious the case. If situate on the face, head, trunk, or genitals, it is more dangerous than on the extremities. If the constitutional symptoms are both antecedent and concomitant, and of a marked asthenic type, the case is one of danger. In early childhood and advanced age, the balance of life is very delicate, and easily turned ; erysipelas may operate much to the patient's disadvantage, and even fatally. Previous habits of intemperance, atmospheric influence of a sinister kind, exhaustion by previous disease, engender intolerance of erysipelas, even when apparently slight, and cloud the prospect of speedy and satisfactory cure.

Treatment.—This must not be of the abortive or ectrotic character ; whether the disease be of local or constitutional origin. If the former, sudden arrest is apt to be followed by sudden reappearance of the inflammatory process in another part—it may be in the integument, or it may be in the lining membrane of an important internal cavity ; metastasis occurs, and often unfavourably. If the ~~former~~, natural relief to an oppressed system is thwarted ; constitutional disorder is not only not relieved, as it should have been, but becomes perhaps seriously aggravated. The treatment, then, will not consist of direct repellents, but of such local means as favour gradual resolution ; invariably accompanied, and if possible preceded, by search for and removal of the apparent cause.

In most cases, as already stated, the predisposing cause is derangement of the primæ viæ. If an emetic be not otherwise contra-indicated, it is an excellent commencement of practice ; unloading the stomach, promoting the flow of bile, and usually inducing a profuse perspiration from the general surface. It is followed by a purge, usually of a mercurial kind—say calomel and jalap—performing the same good office for the bowels which the emetic has done for the stomach. The antiphlogistic regimen is enjoined ; and if the constitutional symptoms be prominently sthenic and inflammatory, antimony is exhibited moderately. If secretion in general, but more especially from the intestinal canal, threaten to remain of a vitiated character, the list of alteratives is applied to ; and of these, the hydrargyrum c cretâ may be mentioned as especially useful, in overcoming the obstinately dry tongue, arid skin, confined bowels, and scanty urine, with other signs of diminished secretion, which very commonly are found after subsidence of the acute stage of the disorder.

The local applications consist of warm fomentations, whereby the ordinary antiphlogistic results are obtained ; the vulgar prejudice which at one time existed against “ wetting the rose,” has long since subsided. One mode of wetting is indeed highly prejudicial ; that is, by cold,

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repellent lotions; more especially when the disease is so situated, as on the head, face, or trunk, as to render metastasis almost certain to be an important locality. When the tenderness, heat, and pain of the surface are especially great, the focus may be beneficially medicated; as by acetate of lead and opium, in weak solution. In the slighter cases, a comfortable sensation follows dusting the part thickly over by a light and fine powder—as flour, or magnesia; probably on account of stimulus by atmospheric influence being thus removed; but in most cases it is better to dispense with such an envelope, considering it to be of much higher importance to maintain a constant and complete surveillance of the varying condition of the part. To the minor examples, the simply antiphlogistic use of the nitrate of silver is also applicable; but it too is objectionable on the score of concealing the true state of the part; and besides, it sometimes seems to have the effect of, as it were, driving the action from the skin to the subjacent cellular tissue, and so favouring suppuration there—as if inducing a metastasis from the superficial to the deeper strata, and concentration there. We may avail ourselves of its circumscribing power as in erythema; but its direct employment we would consider as applicable chiefly to erythema, and in erysipelas to the minor cases only; those, namely, which have little intensity of action, a limited extent, and are situate on the extremities. Some, seeing the relief which ordinarily attends on spontaneous vesication, have thought of imitating this by direct use of the nitrate of silver, somewhat intensely applied; the result of this additional stimulus to a part already being inflamed, however, is not to subdue but to aggravate the action.

Whenever the action is from the first acute, sthenic, and obviously progressive, local blood-letting is advisable. For this purpose leeches are often employed; but they are apt to do more harm by the stimulus of the wounds—the suction of which seems to be inimical to adhesion, and favourable to inflammation and ulceration, even a previously uninflamed part—than good by abstraction of blood. Punctures, rapidly made with the point of a lancet, are preferable; they are more painful at the time, but the smarting soon ceases; action soon declining from approach to true inflammation, the wounds usually adhere; and on subsidence of the swelling, the cicatrices are so minute and faint as to be almost or wholly invisible. They are more efficient as antiphlogistics than leeches, less apt to irritate, and seldom if ever leave any mark at all approaching to deformity. They fulfil a twofold indication; abstraction of blood, and evacuation of inflammatory effusion. The majority are made to implicate only the rete vasculosum, their object being loss of blood; a few—and only a few such are necessary, the cells of the areolar tissue freely communicating—penetrate more deeply, to the subjacent cellular tissue; their object being to drain off the serous effusion, so favouring vascular relief, and at the same time preventing the occurrence of untoward tension. Hot fomentation is assiduously employed for some time after the infliction of the wounds; being favourable to both indications. And if the sanguineous flow be not altogether satisfactory, it may be increased by the temporary application of a ligature on the cardiac aspect of the part.

This practice by puncture may startle those who are practically unacquainted with it, by its apparent severity; but the severity is only ideal. We grant that in one point, the infliction of temporary pain, it is more severe than leeching; but in every other, it is much and truly superior. Alarming it may be to the timid patient; but it is quickly over—a few seconds suffice—and the relief is both satisfactory and instant. In the more severe cases which demand its use, the pain of infliction is often the least; the acute pain already existing in the part masking that of the punctures; in the same way that the operation of scarifying tense and painful gums seems not unfrequently to be agreeable rather than otherwise to the teething child. And, as already stated, the ultimate cicatrix of each puncture is so trifling, as to render the practice equally applicable to the face, when erysipelatous, as to any other part of the surface.

When abscess forms, whether during the acute progress of the disease, or of secondary occurrence, an early opening is highly advisable, to save both skin and cellular tissue; for although the abscess be not diffuse, but somewhat limited by fibrinous exudation, yet its tendency to rapid extension is greater than in ordinary circumstances.

So soon as the action has begun to subside, there is often a necessity not only for a discontinuance of general antiphlogistics, but for recourse to tonics and support of the system; as in the old or those of previously debilitated frame, and sometimes when the affection is of an asthenic and epidemic character. Wine is given, at first cautiously; with as much plain nutritious food, as the stomach can easily digest. And be it remembered that such tonic general treatment is, in such cases, not incompatible with continuance or resumption of local antiphlogistics, should these be demanded by the state of the part.

In all cases, after the inflammatory action has passed away, gentle and uniform support by bandaging is expedient; preventing congestion, removing the tendency to œdema, and hastening restoration to the normal sthenic condition. But this, and all other tonic treatment, whether local or general, must be both cautiously begun and cautiously maintained; being apt, if carelessly conducted, to prove excessive, and induce secondary suppuration.

Mercurial inunction of the erysipelatous part has been loudly advocated. We are averse to all concealment of an inflamed part; and besides, would dread an undue stimulus from the application, in the early stage of the disease. By Velpeau, sulphate of iron is lauded as a local application; either in solution, an ounce to the pint of water; or as ointment, a drachm to the ounce of lard. Pressure is also a favourite continental remedy, from the first, and however acute the action; when gentle and uniform, it is very useful after subsidence; but until then, however carefully employed, it is more likely to aggravate than to assuage the disorder.

II. *The Phlegmonous, or Cellulo-cutaneous.*—This is an infinitely more serious affection. The action is intense, and rapid in its progress; and a plurality of tissues are involved from the first. The skin and cellular tissue are both acutely inflamed; liquor sanguinis is rapidly exuded, and tension ensues; swelling is great and rapid; a limb, not

unfrequently, is enlarged to twice its normal girth; the skin is red, hot, very painful, tight and shining—showing no rugæ, but smooth and glistening; pressure is very painful, and the part feels as if converted into brawn. Vesication often takes place, in a broad extended form, as in the first effect of a blister; it is rather a favourable sign than otherwise; for sometimes it betokens a subsidence of action. But usually, by the tension, vascular action is farther increased; and unless speedy relief arrive, suppuration occurs. The pus is ill concocted—not laudable, but thin and ichorous; the parts are not protected by any plastic effusion, but open and defenceless; infiltration takes place, rapidly and extensively; cellular tissue is broken up, ulcerates, and sloughs; skin is undermined, and sloughs also. The system sympathizes largely; inflammatory fever at first exists, often intense; but on the occurrence of destructive infiltration, a change is made to the form of constitutional irritation, of a still more alarming character—probably first showing the type of irritative fever, then that of hectic, ultimately that of prostration and collapse.

But the disorder, and its effects, are by no means limited to the textures primarily involved. Suppose the case to be both intense and neglected. The inflammatory action spreads by contiguity as well as continuity, and that rapidly. Fascia is involved, and sub-fascial cellular tissue; the tension which results from this is greater and more serious than from merely subcutaneous infiltration; and the action is proportionally aggravated. Intermuscular cellular tissue is implicated, and muscles are detached by its disruption; periosteum inflames, and suppuration—still diffuse—takes place beneath it; bone inflames and dies; joints are opened into, inflame, and suppurate; and inflammation, diffuse suppuration, and sloughing, having at length more or less involved almost every texture of the limb, the suffering frame may demand amputation to save life; or death may ensue, ere ever an opportunity for operation occur. Such fatal issues are not unfrequent; but still more common are stiff joints, necrosed or carious bones, withered limbs, and wasted frames—the results of ill-treated phlegmonous erysipelas.

The constitutional symptoms which attend on this grave malady are of three kinds. 1. Of a bilious character, as in most examples of the simple form, preceding and ushering in the local disorder. 2. Inflammatory fever, during the rise and progress of the inflammatory process. 3. Constitutional irritation; the suppuration having formed, and by infiltration advancing rapidly in its devastating progress. The causes are similar to those of the simple form.

Treatment.—This, in the first instance, must be mainly constitutional, as in the simple. Emetic, purge, antiphlogistic regimen, antimony, and perhaps venesection. Were our object simply to overcome an intense inflammatory process hastening on to dire results, we should bleed always; but we know that in many cases the sthenic stage is but brief, the asthenic early and serious—more especially when the disease is of an epidemic character; and that in all cases, if the action be not arrested in its very rise, suppuration and infiltration are inevitable, and certainly followed by constitutional symptoms tending to the lowest

type. Only at the very commencement of the case, then, in patients previously robust, and when the symptoms hitherto have all indicated the sthenic character, is the highest antiphlogistic remedy, general bleeding, advisable; and even in those cases in which it is expedient, it must be practised with a cautious economy of the "liquid living flesh"—for, as in compound fracture and other severe injuries followed by inflammation, however acute and sthenic the action may be at first, a long day of trial to the system by debilitating causes may be fast and surely impending. In very many cases, our aid is not demanded until the period for active local treatment has arrived; and then local bleeding, which is essential, can be made to have a constitutional effect.

We have the high authority of Mr. Liston for considering aconite and belladonna useful, in small doses, during the acute stage; beginning with the former, and giving half a grain of the recent extract either in substance or in aqueous solution, repeated every third or fourth hour; it is said to diminish arterial force, produce perspiration, and by lessening action to mitigate tension and the other urgent local symptoms. Then to prevent reaction, the extract of belladonna is administered, in the dose of a twelfth of a grain, repeated at similar intervals. I have to confess to no experience of this; and farther, to being quite satisfied with the ordinary antiphlogistics, even in the most acute cases,—blood-letting, purging, opium if necessary, and the antimonial solution.

The affected part is placed at rest, elevated, and with its muscles relaxed. At first, the most suitable application is hot fomentation; and under this, with appropriate constitutional treatment, the case may resolve. More commonly, however, the action advances, swelling rapidly increases, and tension with aggravation of pain ensues; liquor sanguinis—not serum, or serum principally, as in the simple form—has been effused; if the action progress farther, the effusion will rapidly degenerate into an ill-conditioned pus, which will be widely infiltrated into the defenceless texture around; the cellular tissue is doomed, the existence of the integument has grown precarious, and constitutional disaster is inevitable. This then is the period for action; a period both early and brief. The effusion must be permitted to escape, and loss of blood, copious and direct, is necessary to arrest the advancing action. Punctures evacuate serum readily enough, and the loss of blood which they occasion is sufficient to allay an inflammatory process of no great intensity; they are consequently very suitable in simple erysipelas; but for the phlegmonous, they are altogether insufficient. Punctures are superseded by incisions; the lancet by the scalpel or bistoury. Through the incision, liquor sanguinis drains away, ere yet it has degenerated, or while it has just begun to do so; blood is drawn rapidly and in sufficient quantity to arrest the local action, at once limiting farther effusion, and preventing degeneration of this from inflammatory action; and the effusion, comparatively slight, which does continue, has no opportunity to infiltrate, but at once finds a ready access to escape. This is the true time for incision; saving disruption and sloughing of cellular tissue, danger to skin, and serious disorder of

system ; while the action is yet comparatively recent, and just in the act, as it were, of surmounting its true inflammatory crisis ; when the part is tense, red, shining, painful, throbbing, and feels like brawn. At a subsequent period, when suppuration has occurred, and the deadly infiltration of purulent fluid begun, incision is demanded with equal, or even greater urgency ; but its object is wholly different ; too late to save tissue and prevent disaster ; in time only to mitigate, and perhaps limit, destruction already done. The knife, when used at the proper time, need not go deeper than the subcutaneous cellular tissue ; the action and its results have as yet extended no farther. But when used at a later period—too late to prevent mischief, and only in time to limit—it must perforate the subjacent fascia as well ; in fact, it must reach all the infiltrated textures, otherwise it might almost as well be altogether omitted. This therefore is another argument in favour of early incision.

The treatment of phlegmonous erysipelas by incision, may be said to be as old as the surgery of the 16th century, according to Prospero Alpini ; but its true introduction into practice is comparatively recent, by the exertions of Mr. Copland Hutchison and others. It seems a severe remedy ; and doubtless so it is. But it seems more cruel than it really is—the wound looks both wide and deep at the moment of infliction, but in a few days, sometimes after but a few hours, subsidence of the swelling may have reduced it to a comparative scratch ; and besides, even though it were altogether as severe as it seems, no other proceeding will prove equally efficacious ; *ad extremos morbos, extrema remedia*. There is now hardly any question as to the propriety of free incision after suppuration has occurred ; there is no other means of sparing both part and system. But some are not fully persuaded of the justice and expediency of the practice, at the earlier period, when the infiltration is only as yet of liquor sanguinis, and when the action has not yet reached its crisis. But we think, that a due consideration of the indications which such treatment comprises, and the paramount importance of the fulfilment of such indications, is not unlikely to reconcile them to the seeming cruelty.

At one time, also, it was matter of dispute, among those who favoured the practice of incision, whether the wounds should be long or short. Whether the knife should be entered at the upper part of the inflamed texture, and carried down continuously throughout its whole extent, however great that may be ; or whether it should be applied only to those parts most implicated, where tension and pain are greatest, and infiltration and suppuration most imminent. Seldom if ever is the whole part equally affected ; some points of the surface—perhaps the greater number—may show only the characters of simple erysipelas, or little more, while in others the phlegmonous symptoms are in active progress ; by the latter only are incisions demanded. Consequently we find that common sense and common practice have decided in favour of the “ short cut ” system ; and no longer, as has been well observed by Professor Cooper, are yard-measures required for ascertaining the extent of incisions in erysipelas. To enter a knife over the great trochanter and withdraw it only when it has reached the knee, or not

until even the outer ankle has been approached—as has been done—is to inflict a very serious wound ; much loss of blood, shock to the system, and protracted suppuration ; which triumvirate, becoming associated with the exhausting effect of the natural progress of the disease, is not unlikely to overpower the system. A few small wounds, implicating only those portions of the texture where their presence is essential, are not only much less serious as an additional mechanical injury, but more effectual as a remedy.

The hemorrhage is direct and copious ; and is permitted to continue, until sufficient shall have flowed for satisfactory evacuation of the part ; and, as formerly stated, in many cases the loss is carried a step further, so as at the same time to afford a sedative result upon the system. Should the flow threaten to prove excessive, the part is elevated, and pressure temporarily applied on the bleeding point or points, either by the finger, or by lint and bandage. It is very seldom that any vessel is wounded of sufficient size or activity to require a ligature. In some cases, when we have hazardous local action, with much impairment of general power, we are constrained to incise, and yet very loath to shed blood ; in such circumstances, the wound will be as limited as possible in both extent and depth, and temporary pressure, with elevation of the part, will be had recourse to, almost immediately after the infliction.

After bleeding has ceased, pressure—if employed—is withdrawn, and fomentation resumed ; and during the intervals of fomentation, a light warm poultice is applied to the whole inflamed surface ; favouring extravascular exudation—which is now harmless, because readily escaping so soon as formed, and not accompanied by true inflammation ; and expediting subsidence of the whole action. The wound itself inflames and suppurates, and not unfrequently a thin ash-coloured slough coats its margins ; but the surrounding cellular tissue retains its integrity ; its anormal liquid contents gradually exude ; swelling falls rapidly ; redness, pain, and tension all disappear. This resolute process will be found far advanced in the course of two or three days ; and then, both fomentation and poultice, but especially the latter, are to be discontinued ; to employ them longer would be to render certain the occurrence of those untoward relaxing and suppurative results formerly stated. The fomentation is altogether laid aside ; and instead of poultice to the whole surface, tepid water-dressing is applied merely to the wound or wounds, and changed as often as the discharge—at first usually profuse—renders necessary on the score of cleanliness. To the general surface early support by uniform bandaging is expedient, for like reasons as in the simple form, but more urgently demanded ; at first, let the application be especially gentle, otherwise the stimulus of pressure, coming with the support, may reinduce vascular action ; and in those cases in which suppuration has occurred, cellular tissue sloughed, and skin been to some extent undermined, caution in bandaging is most necessary throughout, otherwise injury may be done to vessels more or less isolated by the destruction which has raged in the common textures around. At the same time that local support becomes expedient, so does support of the system ; and in many cases of the phlegmonous, as of the simple erysipelas, the general tonic system of treatment is required

at an earlier period, while, local antiphlogistics are still in use ; general support and local depletion being by no means incompatible.

The wounds, on subsidence of the general swelling, shrink greatly in their dimensions ; and, as both part and system recover tone, discharge diminishes, and healthy granulation advances. During separation of the superficial sloughs, water-dressing is applied ; after separation, this is more or less medicated, as the character of the granulations may seem to require. Not unfrequently there is a tendency to great exuberance of granulation, delaying the cure, and producing an unseemly bulging cicatrix when that is at length obtained ; this is best obviated by early adoption and due maintenance of well arranged pressure.

There is the same necessity for guarding against the occurrence of secondary abscess, as in the simple form.

Phlegmonous erysipelas has sometimes been thought to be contagious. On this subject, however, opinion is found greatly to vary. And during the unsettled state of the theoretical question, it is well to keep on the safe side in practice, by treating the disease, especially in hospital, with every precaution against communication.

Not unfrequently it is complicated with other maladies, also of a serious nature. Phlebitis and inflammation of the lymphatics seem to own the same predisposing and exciting causes ; the predisposing being constitutional disorder of a bilious character, sinister atmospheric influence, or both ; the exciting—wounds, and other mechanical injuries, more especially when treated unskillfully.

III. *Oedematous Erysipelas*.—This is a low grade of action in a weak system ; and the same textures are involved as in the phlegmonous form. True inflammation is not reached ; and the characteristic effusion is that of serum in the subcutaneous cellular tissue. Swelling is great but gradual, soft, and pitting deeply and durably on pressure. There is no tension, little heat or pain, itching rather is complained of, and the redness is of a pale hue. The extremities, especially the lower, are the parts most frequently affected. The constitutional symptoms are but slight ; there is obvious derangement of health, more of the asthenic than of the sthenic character, yet scarcely referrible to any peculiar type.

Treatment.—Punctures are advisable, but they need be few in number ; for, slight loss of blood will suffice to moderate the action, and not many apertures are necessary for effectually draining off the serum. For a day, or so, fomentation is employed, and then uniform bandaging is had recourse to—at an earlier period, and more perseveringly maintained, than in any other form of erysipelas ; there is little risk of reinducing action, and stimulation of the absorbents is the paramount indication. At the same time, diuretics will probably be expedient, as in other examples of serous effusion. General disorder of secretion may require alteratives ; withal a tonic system of treatment is to be maintained, and sometimes it requires to be rather actively pursued as soon as subsidence of the local action will admit of this.

IV. *Bilious Erysipelas*.—This term is applied to those cases of Erysipelas, in which the symptoms of biliary derangement not only precede local action in a marked form, but are throughout the whole progress

of the case of a very prominent character. Either simple or phlegmonous erysipelas may be so characterized; but the former by far the more frequently; in truth the local action is usually slight, seldom reaching suppuration; and the constitutional symptoms also partake in but a slight degree of the inflammatory type. The more prominent general symptoms are headach, nausea, bilious vomiting, pain or weight at the epigastrium, thirst, loathing of food, eyes and face suffused, general hue yellow, sclerotics especially discoloured, foul dry tongue, and a bitter bad taste in the mouth, bowels constipated, urine scanty, and depositing a copious turbid sediment. Locally, the ordinary signs of the inflammatory process are but slight, and the redness is almost merged in the prevailing yellow discolouration of the integument.

The treatment will be mainly of the constitutional kind; emetics, purgatives, alteratives, diuretics, and diaphoretics, as circumstances require; and on these the practitioner is mainly to rely for cure of the local as well as of the general symptoms. Treatment of the part is but a secondary matter; and is slight in proportion to the action for which it is demanded; fomentation, rest, bandaging; seldom abstraction of blood.

V. *Erratic Erysipelas*.—The peculiarity of this form is the tendency to shift from one part to another; not extending merely, and occupying a larger space, as the simple erysipelas does: nor leaving one part suddenly to reappear at another somewhat distant, as any form of the disease may do; but leaving one part for another, and yet maintaining the extension continuous and unbroken. The action is invariably slight; often little more than a mere erythema. The occurrence is almost uniformly indicative of a feeble and impaired system. The constitutional symptoms are always antecedent as well as attendant, of the asthenic kind, and if not actually typhoid, tending manifestly thereto.

The treatment accordingly has little to do with the affected part. Fomentation and rest suffice; and if the spreading be in an unfavourable direction, as towards the face or scalp, it may be diverted into another course by the use of nitrate of silver as a limiting agent. The system mainly occupies our regard. Alteratives, tonics, stimuli, are given as required. When sinking has fairly threatened, in addition to the ordinary means of support, turpentine, given by both mouth and rectum, will be found an excellent remedy.

Hospital Erysipelas.

This term is often applied to the disease, in all its forms, as occurring in hospital practice; the patient not being admitted labouring under the affection, but seized by it while resident within the institution, on account of other ailments. The phlegmonous form is usually most frequent under such circumstances. And if the cases prove numerous, either the disease will be found at the same time prevalent out of doors, untoward atmospheric influence conspiring thereto; or some serious fault will be apparent in the hospital management, as regards ventilation, dressing of sores, and bestowal and arrangement of patients. The chief peculiarity of hospital erysipelas is, that usually the asthenic type

prevails, even in the most urgent cases : and that consequently, as a general practice, energetic spoliative and depressing antiphlogistics are not advisable in the treatment.

Our attention is to be chiefly directed towards prophylaxis. The number of patients in one ward should be few ; and those with foul running sores should be carefully segregated. The sores should be dressed lightly and simply, avoiding all stimulating acrid applications, lest, over-action follow, and the spreading or erysipelatous character supervene. No sponges should be permitted to appear within the wards ; and every possible means should be taken to avoid community of dressing, and contamination of sores. Dressing is to be renewed as often as cleanliness demands ; not unnecessarily, lest the sore resent and inflame ; not too seldom, otherwise pus accumulates and putrefies, irritating not only the sore and its vicinity, but polluting the whole atmosphere of the ward, and injuring all its occupants. Ventilation and general cleanliness of the apartments are also most essential. And, as formerly stated, it is well to use all precautions, as if the disease were undoubtedly contagious.

Thus then we find the general characteristics of the erysipelatous inflammatory process, in its more marked forms, to be ; tendency to spread ; tendency to change its site by metastasis ; tendency to prevail in an epidemic form ; deficiency of concomitant fibrinous and plastic effusion ; rapid attainment of the suppurative crisis ; the pus, as if imperfectly concocted, thin, and non-laudable ; by its diffusion, danger to texture great ; in the constitutional symptoms, the inflammatory type seldom predominant ; tendency to the asthenic character usually strong, often even from the first ; gastric and biliary disorder, with general derangement of secretion, primary and great ; active local treatment not advisable when texture is not in danger, but when diffuse suppuration is either threatened or established, free incision alone remedial ; active constitutional antiphlogistics in few cases well borne, unnecessary except in the most sthenic and intense examples, and even then to be employed with much prudence and moderation ; in the majority of cases, and at a comparatively early period in all, constitutional support on the contrary demanded. In short, an asthenia, or tendency thereto, reigns throughout ; and by some this is accounted for by supposing a poisonous influence to be exerted on the system, either generated within, during and by the inflammatory process—or conveyed from without, by atmospheric influence or by direct contagion.

HOSPITAL GANGRENE, OR HOSPITAL SORE.

This was at one time a scourge of hospitals, both in civil and in military practice, especially in the latter ; but since both the treatment of sores and management of hospitals have much improved, of late, it

is of comparatively rare occurrence ; and when it does appear, it seldom evinces those formidable and intractable characters which formerly used to carry devastation and death.

It seems to have been known and described by the old writers, as *Ætius*, *Paulus*, and *Avicenna* ; but was not noticed, prominently and distinctly, till during the late wars, in the end of the last century and beginning of the present. Then, from the crowding of wounded men in hot, dirty, and confined apartments, perhaps after long and rough carriage, with bad food, mental depression, and insufficient attention to dressing and cleanliness, foul degeneration of sores became not uncommon ; and Hospital gangrene came forth in all its virulence—as the graphic pages of *Hennen*, *Blackadder*, and *Boggie*, sufficiently testify.

Within these few years it made its appearance in the Surgical Hospital of this city ; in a slight form ; and obviously attributable to insufficient ventilation and purification of the wards. Suitable attention to this, and temporary removal of the patients, sufficed for its removal.

The disease is an example of sloughing phagedæna. It may be produced directly by contagion, more indirectly by infection ; or it may occur independently of either—from crowding, evil dressing, or noxious atmospheric influence. Mercurialism is especially favourable to its accession. It may either seize on a wound already existing, or appear in a part previously entire.

On an unbroken surface, the first appearance is usually either a pustule or vesicle ; small, dark, and accompanied with sharp stinging pain. On the giving way of the cuticle, a slough is formed ; and this continues to extend both in surface and depth. After a time the slough begins to separate ; but without arrest of destruction in the part, this being continued by acute phagedæna, often with greater and more unremitting pain than before ; then sloughing appears ; and so the work of local death advances—invariably accompanied with profuse, fetid, and thin discharge. Sometimes the progress is so rapid as to cover a large space within a few hours ; in other cases, the advance is reckoned more conveniently by days than hours. The ulcerous cavity is of a circular form, as if scooped out by an instrument. The edges are jagged, and everted, well defined, and often studded with red points of a peculiar appearance, said to be characteristic of the disease. The lymphatic glands are apt to become affected at an early period ; they enlarge, suppurate, open, and the ulcer is prone to assume the same action as the original sore. The surrounding parts are swollen, red, tense, painful, and of a dark livid hue ; and this inflammation is apt not to remain limited, as a mere antecedent to the local death, but to spread, and add the serious complication of erysipelas to the original malady. And thus hospital erysipelas and hospital sore may be found to co-exist.

When a wound is attacked—as is most frequently the mode of accession—it first inflames, and the pain is severe, the patient complaining as if wounded there by an insect ; discharge is diminished, or may be for a time altogether arrested. Then the granulating surface rapidly changes, assuming a dirty white colour ; and sometimes becoming spongily elevated and crepitant, by air, the product of putrescence. The surrounding skin swells, and is of a purplish hue. Slough forms,

either in one continuous mass, or in detached portions. The dead matter begins to separate, but not by a healthy process; the edges harden, evert, remain of a dirty white appearance, and pour out much fœtid discharge—very different from the healthy pus which escaped but a few hours before. Sometimes the body of the sore has not the gray or whitish colour, which usually obtains, but is dark from the beginning, the sloughing parts being infiltrated and mixed up with putrid extravasation. The degeneration generally commences at the edges, but rapidly invests the whole; and the continuance of the malady is also chiefly marginal.

The constitutional symptoms, in whatever way the local malady may have made its attack, are invariably formidable—constitutional irritation, typhoid, and tending to collapse. As in erysipelas, they sometimes precede and usher in the local change; sometimes they are only consecutive and attendant; when antecedent they are always aggravated by the occurrence and extension of the local disorder—an event not invariable in erysipelas. In some very few cases, when the patient was just before robust and in rude health, and has suffered by direct contagion, the introductory constitutional symptoms may be of the inflammatory type; but even then, these will be very transient, and soon become merged in irritation. More frequently the commencement is with irritative fever, this glides into the confirmed typhoid, and sinking follows. Along with the corporeal depression comes mental despondency—"The bravest soldier betrayed a symptom which, in those of less strength of mind, formed a striking feature in every stage of the disease; namely the greatest imaginable impatience of pain, and depression of spirits. Those who had borne amputation without a groan, shrunk at the washing (?) of their sores, and shuddered at the sight of a dead comrade, or even on hearing the report of his death; instantly predicting their own dissolution, and sinking into sullen despair."*

No texture is proof against the ravages of this disease. The arterial resists longest, but in the end gives way; and hemorrhage ensues. For there is not, as in ordinary gangrene, more especially when of the chronic kind, the solidifying of the arterial contents, with occlusion of the canal up to the nearest collateral branch. The death is rapid, and the slough peculiarly humid and soft; circulation, though feeble, goes on till sphacelus is complete; and besides, it is probable that the blood's power of coagulation has been much impaired, as happens in other examples of poisoning of the system. This bleeding may be favourable, as formerly stated, if only to such an extent as to affect the part—resolving the inflammation which precedes and leads to the local death; more frequently it is profuse and prejudicial, increasing the prostration, and hastening the fatal issue. "The third and last stage was now fast approaching. The surface of the sore was constantly covered with a bloody oozing, and, on lifting up the edge of the flabby slough, the probe was tinged with dark-coloured grumous blood, with which also its track became immediately filled; repeated and copious venous bleedings now came on, which rapidly sank the patient; the

* Hennen's Military Surgery, p. 219.

sloughs, whether falling off spontaneously, or detached by art, were quickly succeeded by others, and discovered on their removal small thickly-studded specks of arterial blood. At length an artery sprung, which in the attempt to secure it, most probably burst under the ligature; the tourniquet or other pressure, was now applied, but in vain; for while it checked the bleeding, it accelerated the death of the limb, which became frightfully swelled and horribly fetid. Incessant retchings soon came on, and with coma, involuntary stools and hiccough, closed the scene.”*

Or instead of advancing to a fatal issue, recovery may take place. In this country, and at the present day, this is the general rule; death, and even much local destruction, form the exception. The constitutional disorder gradually abates; pain diminishes, and the inflammation of gangrene is succeeded by that of arrest; sloughs separate, and are neither renewed, nor supplanted by phagedæna; the discharge becomes less copious, thin, and fetid, more purulent and laudable; granulation and repair are established. But such amendment is not to be reposed in implicitly; anxious care is yet requisite; for relapse is by no means unfrequent.

Treatment.—As in hospital erysipelas, prevention is the chief object of the practitioner; and is to be obtained by similar means. When the disease has occurred, the treatment is of that kind formerly recommended for sloughing phagedæna in general. Locally, escharotics, efficiently applied, and repeated if necessary; followed by poulticing or water-dressing, until sloughs separate, and healthy granulations appear. By the chlorides of lime or soda, the fætor may be corrected. Constitutionally, gentle yet effectual cleaning out of the primæ viæ, calmatives, anodynes, if need be stimuli. Bleeding or other powerful antiphlogistic remedies, are never warrantable; and mercury is to be avoided as a poison. On arrest of the local action, the constitutional disorder often voluntarily subsides.

FURUNCULUS, OR BOIL.

This is a limited inflammation of a small portion of the skin and cellular tissue, ending in death of the latter, and accompanied by laudable suppuration; always of the sthenic type. It is not a mere pimple; for that is but inflammation and suppuration of an obstructed sebaceous follicle. Nor is the term to be regarded as synonymous with carbuncle; for that is more extensive originally, liable to spread secondarily, and both generally and locally asthenic throughout, sometimes, nay frequently, bringing life into serious peril. Whereas the boil is not only sthenic in itself, but rather indicative of a robust and plethoric system; at all events, the attendant constitutional disorder partakes more or less of the true inflammatory type, and requires to be treated accordingly.

* Hennen's Military Surgery, p. 220.

The affection is most frequent in the young and middle aged, and in those who eat freely, and are liable to stomachic and hepatic derangements. The most common site is where the skin is thickest—and perhaps most removed from abstergence and ablution—on the back, shoulders, hips, back of the neck and thighs.

Boils seldom occur singly, but are gregarious. The swelling is of a conical shape; its apex yellow; its base hard, red, and exquisitely painful. The pus is superficial; the slough is at the base. Sometimes the slough, or core, as it is commonly termed, consists only of cellular tissue; sometimes a portion of the true skin is implicated; not unfrequently an addition is given to its bulk by commixture with fibrinous exudation. If left to itself, the boil bursts at the apex, and the matter escapes by a single aperture; sometimes this is sufficient to permit a free passage to the slough when loose; more frequently it is insufficient for this purpose. On purulent discharge taking place, the pain, heat, and surrounding swelling usually abate; but subsidence is not complete until slough as well as matter has been extruded; the former, so long as retained, acting the part of a foreign body, and maintaining perverted vascular action.

The predisposing cause is derangement of the primæ viæ, and consequently of secretion in general. The exciting, is some direct stimulus of the part; as by a prick, scratch, or evulsion of a hair. Not unfrequently, no exciting cause exists; the predisposing alone is sufficient.

Treatment.—During the nascent condition of the inflammatory process, fomentation is used, with water-dressing or poultice. On supuration having occurred, an incision is made in the apex, sufficient to insure discharge not only of the pus, but of the slough also; if an opening already exist, it is dilated for the like purpose. The part is kept at rest; and after ejection of the slough, the granulating wound is dressed in the ordinary way. The constitutional treatment—not the least important—consists of purgatives followed by alteratives, to cleanse and rectify the primæ viæ; and somewhat of the antiphlogistic regimen should be enjoined throughout the whole process of cure. To prevent relapse, experience speaks in favour of two very opposite remedies, alkalies, and mineral acids; the liquor potassæ, and the dilute sulphuric acid; given in small doses three times a day, and continued for a considerable period. In each case the ordinary gastric indications will determine which class of remedy happens to be the more suitable.

ANTHRAX, OR CARBUNCLE.

This is more extensive and altogether more important than the preceding. Inflammation of an asthenic type attacks the cellular tissue; and this sloughs at an early period of the invasion; the super-imposed skin is secondarily and less involved, becoming gangrenous only to a comparatively slight extent, and not continuously, but usually in small

Carbuncle is an inflammation of the cellular tissue, and is characterized by the formation of a large, deep, and painful abscess, which is usually accompanied by a large, dark, and necrotic slough.
See 1844, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

unconnected patches. Through the openings thus formed, a foetid sanious pus oozes out, with portions of sloughed and disintegrated cellular tissue. The general swelling is flat, dark, and spongy; a dull burning pain is felt in the part, and in the early stage is much increased by pressure; the surrounding integument is livid, painful, and swoln. Carbuncle is usually found in the same situations as furunculus; but unlike it is generally solitary. It may vary in size from that of a prune to that of a soup plate. The progress is usually slow; ordinarily limited to the surface; but sometimes the deeper parts are also involved, so as to expose cavities, canals, and bones.

The constitutional symptoms are asthenic throughout; at first of a simply febrile and bilious character; then showing typhoid signs; and, as the hidden gangrene extends, tending rapidly towards prostration—more especially in the old—with hiccup, cadaverous countenance, feeble pulse, delirium, and coma.

The disease most commonly occurs in those of middle age, or further advanced in life; and especially in those who have indulged freely and habitually in the pleasures of the table. It is not contagious. The constitutional symptoms invariably precede. The local change begins with a hard painful swelling, mainly subcutaneous, which rapidly enlarges, with dark discolouration and burning pain; vesicles form on the skin; and on the cuticle giving way, the sloughy apertures of the skin are disclosed, as formerly described.

Treatment.—Free and early incision is to be made, usually of the crucial form, throughout the whole extent of the diseased mass; this evacuates the purulent formation, affords an exit for the sloughs when loose, and limits infiltration. But this is not enough. Potassa fusa follows the bistoury, and is used freely; by it the dying parts are at once converted into a dead eschar, healthy separation is accelerated, and injury of the system from absorption of the deleterious products of humid putrescence is almost at once arrested; and, further to ensure fulfilment of the last indication, the slough, as it loosens, is to be carefully removed by knife or scissors. The practice seems severe, but no other will prove in all respects successful; and the more advanced the case, the greater the necessity for its adoption. Less pain is occasioned than might be supposed, the greater part of the cauterized tissues being already in a gangrenous state. Poultice is applied till the slough is discharged; then water-dressing, early medicated to meet approaching debility.

The constitutional treatment is never thoroughly antiphlogistic. At the commencement, evacuants are necessary; for the stomach and bowels an emetic and purgation; for the liver, mercury, cautiously administered; then occasional alteratives, as perhaps the hydrargyrum c cretâ. Early, tonics and stimulants are required—bark, wine, ammonia, brandy, turpentine enemata, according to the features and exigencies of the case. So long as the power of swallowing remains, the remedies are to be perseveringly administered; for, provided the suitable local treatment has been practised, patients often rally successfully, even though previously *in extremis*. Omit the use of the bistoury and potass.

From the commencement to the end, the patient is to be kept in bed, and the diet to be light and nourishing.

—and all constitutional care, however skilful and unwearied, will not arrest the tendency to collapse, or avert a fatal issue.

These strong expressions, in favour of strong remedies, are of course applicable only to the more serious and urgent cases. There are many examples of the disease, in which the swelling is but small, and constitutional disorder proportionally slight; in these simple incision suffices; in a day or two the slough is discharged, and granulation advances favourably.

DIFFUSE CELLULAR INFILTRATION.

This resembles the phlegmonous erysipelas; but the skin is not originally involved. In the subcutaneous cellular tissue an asthenic and rapidly destructive inflammatory action occurs; causing profuse secretion of thin, acrid pus, which is extensively and diffusely infiltrated, entailing the most ruinous consequences on the texture so affected. The skin is undermined, or laid over a mass of slough soaked in purulent secretion, ere yet it has itself begun to inflame. Sooner or later, however, it does undergo that process; and this occurring, after loss of both mechanical and vital support, soon overcomes its vitality; it sloughs to a greater or less extent; and on detachment of the dead portions, the gangrened mass beneath is disclosed. There is no limiting fibrinous exudation, of a plastic kind; the surrounding tissues are all open and defenceless, and may suffer by continued infiltration to an almost indefinite extent.

Usually this affection is connected with the inoculation of a specific virus, which has the doubly unfavourable effect of raising vascular action, while vital power in both system and part—but especially in the latter—is very much impaired. The bites of reptiles, stings of insects, and punctures received during dissection, are familiar examples of such exciting causes. Or the evil matter may come from within—not the less deleterious on that account; for example, urine infiltrated into the cellular tissue is certain to light up an asthenic and rapidly destructive inflammation there, with speedy extension of the mischief by diffuse infiltration of the non-laudable inflammatory product; and the skin usually sloughs early and extensively.

The symptoms of diffuse cellular infiltration, however caused, are asthenic throughout. And never, even at the first, is there inflammatory fever, as in the phlegmonous erysipelas—the disease which it most closely resembles. There are pain, tenderness, a puffy diffused swelling, heat, and sometimes a sense of throbbing; but with no apparent affection of the skin at first, which retains its normal hue, and may seem even paler than the surrounding parts; very soon the swelling, increasing fast, causes tension of the integument; and speedily thereafter, the skin reddens, obviously inflames, and stands much in danger of perishing by sloughing, ulceration, or both. When the surface has given way, the discharge is profuse, thin, offensive, often bloody, and

mingled more or less with the disintegrated cellular tissue. The constitutional symptoms follow immediately on the first accession of the local, and rapidly increase in severity; they are those of constitutional irritation, and tend strongly to the typhoid character.

Treatment.—The nature of the inflammatory action is such as to afford no hope of its arrest before the suppurative crisis has been attained. Leeches and punctures are of no avail; there is no time suitable for their employment; the action almost at once reaches suppuration; and herein again therefore the affection differs both from erysipelas, and from the ordinary inflammatory process. A certain amount of cellular tissue must be broken up and perish; treatment can only mitigate the mischief already done, and prevent its further extension. Incision is to be freely made, throughout the whole extent of the infiltrated part; or if the infiltration be so situated as to render such extensive cutting unsafe and inexpedient, at least let the wound be free, early, and dependent. The infiltrating fluid escapes, tension is relieved, a sufficient drain is left for the continued secretion, with space and freedom enough for discharge of the parts already destroyed. The subsequent local management, and the constitutional treatment throughout, are to be conducted on precisely the same principles as in the advanced cases of phlegmonous erysipelas, in which similar injury has accrued to both part and system.

CHAPTER VIII.

PERVERTED VASCULAR ACTION OCCURRING IN BONE.

To perverted vascular action occurring in the investing membrane of bone, the term *Periostitis* is applied; in the substance of the bone itself, that of *Ostitis*. But be it understood that these terms are not synonymous with true inflammation of the tissues affected, but include the whole range of the inflammatory process, from its first and slightest commencement, up to its highest and most destructive result. According to the issue, also, various names are applied;—plastic matter may be effused, causing *Node* or hypertrophy of bone; absorption may occur, causing either general atrophy, or local loss of substance; suppuration, *Abscess* of bone; ulceration, *Ulcer*; ulceration of an intractable and peculiar kind, *Caries*; death of bone, *Necrosis*.

Periostitis.

This may be the result of direct external injury, as by wound or blow; then its character is usually acute. Or it may originate from

internal causes—and from none more frequently than from a vitiated state of system induced by imprudent and unnecessary mercurialism ; then its progress is usually more staid and chronic. Or internal causes may be combined with external, the former predisposing while the latter excites—mercurialism may co-exist, for example, with exposure to untoward atmospheric influence;—and then the progress and character of the disease may partake of both the chronic and the acute. The periostitic patient is generally at, or above the middle period of life.

Fibrous tissue, such as periosteum, is not particularly prone to assumption of the inflammatory process ; nor, when assumed, does that process tend to rapid and deleterious advancement, provided it be limited to that tissue. How rarely, for example, does suppuration occur in purely rheumatic affections, however acute ; and we have repeatedly seen how comparatively difficult it is for ulceration to seize on any fibrous investment. But the action, if at all cute or considerable, is seldom limited to the tissue originally affected ; both the subjacent and the super-imposed become involved ; the ordinary inflammatory results proceed both above and beneath ; and on these, in the latter situation, the unyielding nature of the fibrous tissue reacts most unfavourably, causing much aggravation.

Periostitis, whether chronic or acute, is from the first attended with great pain, on account of the unyielding nature of the tissue affected. When, however, in the acute form, the action has reached the subjacent bone and the intervening cellular connexions—as very early happens—then the pain becomes excruciating ; for the inflammatory process is more active in the textures secondarily involved ; tendency to effusion is much increased, and this, being counteracted on either aspect by periosteum and bone, sadly aggravates pain, and at the same time hurries on the higher and more destructive results of inflammatory action. Along with the pain, there is great intolerance of pressure, the lightest touch adding much to the suffering. Swelling is not great ; but from the first tense, and very perceptible to both sight and touch, especially to the latter. At first the skin is pale, lax, and uninvolved in the painful swelling beneath ; sooner or later, however, the swelling becomes more diffuse and general, and the integument grows tense, red, and tender. All the symptoms, but more especially the pain, undergo nocturnal exacerbation—as happens in most affections of the hard textures—and the aggravation is not least distinct in those cases which are most chronic in their nature. Day is the period of waste ; night, that of repair. The inflammatory process, in its lower grades especially, may be considered as analogous to the latter action—nutrition is an exalted and perverted form ; its nocturnal exacerbation therefore may be regarded as but an obedience of a general law. It is probable that the inflammatory process, wherever situated, undergoes this change ; but the occurrence is naturally most marked in the affections of unyielding textures, where decided increase of turgescence and effusion must be accompanied by corresponding aggravation of pain.

Periostitis is invariably accompanied by important constitutional symptoms. If the affection be acute, there is much inflammatory fever. If slow and chronic, there is palpable derangement of the health of a

corresponding type; the patient grows pale, weak and thin; loses his strength, spirits, and appetite; sleep is broken or altogether dispelled by the nocturnal exacerbations; constitutional irritation is plainly developed; it assumes the hectic type, and may advance to most formidable severity.

The membrane is found changed; thickened, and increased in vascularity; softened in the acute form, dense in the chronic. Effusion takes place on both its aspects; diffuse exteriorly, limited towards the bone. In the latter situation, if the action proceed no higher than active congestion, the fibrinous effusion, being more or less plastic, may become organized. A distinct, firm, tender swelling results, termed *node*; consisting of plastic fibrin, undergoing organization, exuded partly from the periosteum, partly from the corresponding surface of bone secondarily involved; and, unless either absorption return in great activity, so as to remove all excessive deposit, or true inflammation supervene to undo organization, that process not only advances to completion, but the fibrin makes transition to cartilage and thence to bone; the swelling then becoming less painful, more defined, hard, and unyielding. In the simply fibrinous state, the swelling is termed a recent or *inflammatory node*; when ossified, *chronic*, or *confirmed*.

When the action is acute and has extended from periosteum to bone, with effusion between, inflammation and suppuration are more likely; the liquor sanguinis is no longer plastic, but degenerates into the purulent formation. And such formation, happening between two most unyielding textures, induces aggravation of all the symptoms. The natural progress of the acute abscess outwards is arrested by the non-ulcerating fibrous investment; the cellular connexions between the periosteum and bone are broken up, and the abscess extends laterally, notwithstanding the limiting fibrinous effusion—the bone becoming more and more stripped of its membrane; the bone itself, by the pressure of the accumulating pus, becomes disintegrated by ulceration, at the point or points most compressed; and further, bone, at once inflamed and deprived of its nutritive membrane, is not unlikely to sink under the complication of evils and become necrosed.

In acute periostitis, such destructive results, by suppuration, may follow in the course of a few days; the system at first oppressed by grave inflammatory fever, subsequently exhausted by hectic. In the chronic form, weeks and months elapse, with but little change in the symptoms, or apparent alteration in the structural results; but with a frame gradually yet plainly yielding before the continued irritation. In the latter class of cases, the membrane is found much thickened, dense, and increased in vascularity; the bone corresponding is usually adherent, opened out in texture, and roughened by nodules of osseous deposit.

Examples are not wanting of the whole skeleton having been involved in periostitis. Such cases, whether chronic or acute, are obviously of a most formidable character, and can hardly be expected to have other than a fatal termination. But usually, the disease is limited to one chain of bones, to one bone, or to a portion of one bone. The parts of the skeleton most liable to be affected are those most exposed to external

injury, whether by mechanical violence or atmospheric exposure; the shin of the tibia, the ulna, the clavicle, the sternum, and the bones of the cranium, especially the frontal. In all aggravated cases, mercury, as has already been stated, is usually much to blame; and the worst cases are those which occur in scrofulous patients, who have suffered from both syphilis and its supposed specific. The triumvirate of mercury, pox, and scrofula, is sadly inimical to health; many and serious diseases are liable to be induced; and of these, aggravated periostitis is one.

Treatment.—It is customary to state that action, healthy and morbid, proceeds with comparative slowness in bone; but such is dangerous doctrine, and may lead to inert and injurious practice. It is surely no tardiness of progress which in a few days, from simple inflammation of the periosteum, brings abscess, ulcer, and necrosis—one, or other, or all. In truth there is no disease calls more loudly for active and energetic treatment than acute periostitis; for by such treatment alone can such disasters be avoided. At the very outset, leeches are to be applied in large numbers; counted rather by dozens than units; and in the robust, young and previously healthy, general bleeding may also be practised; our object is to make a full and decided impression on both part and system, so as to avert the disease while there is yet time to save structure. The part is kept raised, relaxed, and rigidly at rest; and hot fomentations are diligently applied. Other antiphlogistics are not forgotten; starvation, antimony, purgatives. The action having been thus subdued, its results usually disappear, gradually yet satisfactorily; if not, discussion is to be expedited by counter-irritation, and the internal administration of the iodide of potassium—making sure however that the acute action is subdued, before such remedies are adopted.

Sometimes the action seems to be partially arrested, yet does not decline; a tense and painful swelling remains, unabated, and on the contrary tending still to increase. It is plain that relief of tension would be a most important indication in such circumstances. For a similar state of matters, unconnected with bone, we would freely practise incision; tension would be at once relieved, action would speedily decline; the wound would suppurate, and its margins perhaps slough, but granulation and closure would speedily follow. Here, however, similar procedure would be rash and untoward; tension would doubtless be relieved; but with suppuration, which is inevitable, would certainly come either ulceration or death of the bone—the very results which we seek to avoid. Direct incision therefore is plainly unwarrantable. But, by inserting a fine bistoury, or tenotomy needle, at a little distance from the tense part, passing it up over it cautiously beneath the integument, then turning and pressing its edge so as to divide the tense membrane wholly to the desired extent, cautiously withdrawing the instrument, so as to make a valvular, oblique, and subintegumental wound, and finally closing the single integumental puncture immediately with a portion of the isinglass plaster—in fact by completing the wound so as effectually to prevent introduction of atmospheric influence, and thereby obviating the chief risk of suppuration—we may obtain diffusion of the swelling,

relieve tension, and so facilitate both resolution of the action and discussion of its results. This manœuvre, however, requires skill and caution in its performance, and even then is not wholly devoid of risk. It is therefore not to be indiscriminately employed, but reserved for those cases which otherwise prove obstinate, and in which aggravation and suppuration seem imminent.

When matter has formed, acutely, beneath the periosteum, direct incision cannot be too early had recourse to. The part is to be treated as an ordinary acute abscess. By no other procedure can the mischief threatened to the bone be either limited or averted. Abscess having already formed, subintegumental wound is unnecessary; further, it is inexpedient, as insufficiently evacuating the pus. If the wound be early, simple ulceration only will have taken place; on evacuation of the abscess, ulceration quickly subsides, its cause having been removed; reparative action commences, and advances harmoniously with granulation; hard and soft parts cicatrize simultaneously. If incision be delayed, the ulcer not only deepens and extends, but is apt to degenerate, subsequently proving slow to heal; or necrosis may occur to a greater or less extent. But it is plain that this practice, so obviously beneficial in the case of acute abscess, is never to be employed, unless when the indication of such a state of matters are most distinct and satisfactory. Only when the *tactus eruditus* and other signs of suppuration convince us, that pus is really in some quantity accumulating between the periosteum and bone, is direct incision at all advisable.

In chronic periostitis, we also begin with leeching; but in a gentler form; not so much with the view of arresting or resolving the action thereby, as in order to pave the way for its more appropriate remedy of counter-irritation. A few leeches suffice; followed by fomentation; accompanied by rest, attention to posture, and a careful diet. Blisters then follow, in succession; or perhaps varied occasionally with liniment of croton oil; and accompanied by the internal administration of the iodide of potassium, in full doses. By this medicine, rest, and counter-irritation, the greater number of cases will be satisfactorily subdued. Sometimes, on account of peculiar obstinacy, more potent counter-irritation may be expedient; the hot iron may be applied cautiously over the part. Should the iodide of potassium interfere much with the stomach, or seem to have lost its effect by habitual use, it may be either combined with or temporarily superseded by sarsaparilla. Occasionally the pain continues severe, more especially at night, notwithstanding perseverance in such treatment; in these circumstances it becomes advisable to give mercury, even although the case be one in which previous mercurialism is held the cause of the very evil now contended with. The bichloride is considered the preferable form of the remedy in such cases; given cautiously, in doses of a twelfth or sixteenth of a grain, thrice daily; either simply in solution, or in pill with sarsaparilla and guaiac; its use to be discontinued, so soon as the symptoms have satisfactorily given way. But, as a general rule, mercury in any form is never to be given in periostitis, more especially so as to produce a constitutional effect, unless other and safer means have proved unavail-

ing. For that mineral we well know to be as likely to cause as to cure.

Neuralgia of Periosteum.—This membrane is sometimes the seat of neuralgic affection. It may follow amputation; it sometimes results from a comparatively trifling injury. The part affected is usually of no great extent. The skin is free from redness and swelling, but very sensitive; there is no apparent change of structure in either periosteum or bone; but in the former texture severe pain is felt, varying and intermittent—in short presenting all the usual neuralgic characters. Rest, endermoid application of nitrate of silver, and the internal administration of iron, bark, or some other of the many remedies held available in neuralgia, constitute the treatment. This failing, benefit may be obtained from the lodgement of a seton over the affected part.

Ostitis.

As already observed, periostitis cannot long exist, without the corresponding portion of bone being more or less involved. But not unfrequently the action commences in the latter texture. It may affect only the external surface, or originate and exist chiefly in the interior, or involve the entire thickness. Also, it may be either acute or chronic.

Like periostitis, it may be the result of external injury, or atmospheric exposure; or, the cause being internal, it may be termed idiopathic. Or the action may extend from the soft parts, involving both periosteum and bone secondarily; as is not unlikely to happen in many cases of neglected phlegmonous erysipelas. And again, no predisposing cause is found more frequent or certain in its operation than mercury—more especially if this have been both profusely and unnecessarily administered.

The result of the action may be suppuration, internal, external, or general; ulceration, simple or carious; local death, or necrosis. Or the action not reaching true inflammation, and imperfectly resolving, there may be simply change of structure.

I. CHANGE OF STRUCTURE.—At first the bone is softened; apparently by absorption of part of the earthy matter, fibrinous effusion occupying its place. At the same time, its texture becomes more open; its surface presenting a porous appearance; as if the meshes of dilated vessels had pushed aside the softened parenchyma, to make freer space for themselves in their canals and foramina. Then, by continuance of deposit, and this being gradually transformed into an osseous character by transitional organization, the bone increases in bulk; yet, though enlarged, remaining for some time unusually soft and open in texture. But as the action becomes more chronic, and somewhat subsides, organization and transition of the deposit advance more thoroughly, and to enlargement are added both condensation and induration of texture; earthy matter being now deposited in even more than the normal proportion. In consequence of this excess of earthy matter, it is important to bear in mind, that the bone is impaired in vital power; and there-

fore less likely to control a re-accession of the inflammatory process—the liability to suppuration, ulceration, and necrosis, is increased. When the original action has completely subsided, we are not to expect the same rapid and satisfactory disappearance of the structural change as in similar affections of the soft parts; yet the absorbents are not idle; the præter-natural deposit diminishes more or less; and, if inflammatory relapse do not occur, after some time the enlargement and condensation may be greatly removed, and normal texture nearly restored—more especially if the natural resolute effort be judiciously seconded by appropriate treatment. Such resolution, however, can only be hoped for after long time, and under any circumstances is seldom if ever altogether complete.

The progress of the action is indicated by symptoms in the main very similar to those of periostitis. The pain is equally, if not more severe, and has also its marked nocturnal exacerbations; it is more deeply seated, and not so much aggravated by pressure. The soft parts are early and much involved, but, at first at least, in a minor degree of action; in the deeper cellular tissue, exterior to the periosteum, and intermuscular, there is much fibrinous effusion, clogging the muscles, impeding motion, and affording a firm, deep, inelastic swelling; in the superficial cellular tissue, serum accumulates, occasioning more or less œdema. Usually the skin too becomes red, somewhat stretched, and glistening. The constitution sympathizes more or less, according to its susceptibility, and the intensity and duration of the action.

The treatment is as for periostitis; actively antiphlogistic in the outset, in order, if possible, to arrest the progress at once; failing in this, then counter-irritant locally, alterative constitutionally; but at all times let us be ready to cease from counter-irritation, and resume antiphlogistics, should re-accession of acute action threaten to supervene.

II. SUPPURATION OF BONE. (*a.*) *External Abscess.* 1. *Acute.*—We have already seen that in acute periostitis, the subjacent bone is early involved in similar action, that effusion takes place between, and that if the inflammatory crisis be reached, abscess there is inevitable. For such suppuration it is plainly immaterial whether the action originate in the bone or in the periosteum; it soon extends by contiguity to both. The pain is excruciating, distinct rigors usually accompany the act of suppuration, the swelling is considerable and increasing, and ultimately fluctuation may be discerned; at an early period the integument reddens and becomes painful, and the subjacent cellular tissue is infiltrated by serum. The nature of the progress of such abscess has already been considered, as also the treatment which is suitable. By early and direct incision only can mischief be arrested and repair satisfactorily obtained; the matter is discharged, ulceration of bone ceases; and so soon as the inflammatory action has sufficiently subsided from its crisis, granulation begins from both hard and soft parts, and advances towards cicatrization. If incision be omitted, the matter accumulates; tension increases, so does pain, and then comes aggravation of the original action; periosteum is separated from the bone by lateral extension of the abscess, more and more weakening vital power in the

denuded part; this, compressed by the pus, already inflamed, and with its power of controlling action much impaired, readily yields before that pressure; it ulcerates, or may even perish in part by necrosis; and when the external opening and discharge of pus are at length effected, a large suppurated cavity, with ulcer of bone, necrosis, or both, must inevitably complicate the case very unfavourably, and must delay the cure—a complication and delay which it is in our power to avoid by early incision.

2. *Chronic*.—But the action may be altogether chronic and limited, and yet have reached to suppuration; and the abscess may be small, and chronic too—enlarging slowly if at all. In such a case we must be more chary of the knife's use. The bone's surface has been so gradually and gently subjected to pressure, that no ulceration has as yet occurred; were a direct incision to be made, this must inevitably bring a certain amount of acute action as its direct result; and under this acute inflammatory accession, ulceration or even partial death might be induced. Such risk therefore is not to be incurred. The practice, under such circumstances, is to attempt discussion by the means formerly detailed as suitable for absorption of minute chronic abscesses; the matter is gradually taken back into system, so gradually as not to affect that injuriously; the cavity proportionally contracts; and the bone recovers its normal state without having ever sustained solution of its continuity, or been even threatened with exfoliation. Failing in discussion, or should from any cause the chronic abscess become acute, then direct, free, and early incision is to be practised unhesitatingly, as undoubtedly the less of two evils. Superficial abscess of bone, when large, is seldom chronic; but, if such should occur, the same treatment is advisable as for chronic abscess in general; namely, subcutaneous evacuation by a valvular aperture, carefully excluding atmospheric air.

(b.) *Acute Internal Abscess*.—This may be either diffuse or limited.

1. *Diffuse*.—Inflammation has reached the suppurative crisis in the lining membrane of the interior of the bone, and in the vascular meshes of connexion between that and the periosteum; and there is no fibrinous accompaniment, of limiting capability. The pus so soon as formed is infiltrated into the cancellated texture, which—like cellular tissue of soft parts similarly situated—gives way and is broken up, partly by ulceration, partly by more continuous local death. Partly by such destruction of texture, from within outwards, partly by the passage of pus outwards through vascular foramina and canals, partly by extension of the suppurative action from within to the exterior, matter is sooner or later found beneath the periosteum, and ultimately also in the more superficial soft textures; but, as can be readily imagined, not till after some time, much agony, great swelling, and serious constitutional disturbance. The fate of the bone under such circumstances is inevitably untoward; it must fall a prey to either ulcer or necrosis, or to both, and that extensively.

The treatment is to make a free direct incision, so soon as the presence of matter can be ascertained; the pus and disintegrated debris of the cancellated tissue are discharged; farther extension of the mischief is

probably prevented; and an opportunity is obtained, favourable for extrusion of dead parts, and for otherwise remedying the disaster already sustained. Constitutional antiphlogistics are at the same time employed, proportioned to the symptoms; if progress towards cure be slow, discharge copious, and natural power of system weak, hectic is not improbable, and the general remedies must change accordingly.

2. *Limited Internal Abscess.*—The occurrence of this is more rare. The cancellated texture of the heads of the long bones—more especially of the tibia—is the ordinary site; the patient is at or beyond the middle age, and generally has been much exposed to inclemency of weather, particularly during night. The abscess is minute, the suppurated part seldom exceeding the space of a shilling in extent; and it is surrounded and limited by fibrinous effusion, which has not only been perfectly organized, but made full transition into the osseous state. On making a section of the part, the suppurated space is seen bounded by dense recently deposited bone; and this is usually lined by a distinct pyogenic membrane. The texture around becomes affected by osteitis, of a minor grade, causing gradual enlargement and ultimate consolidation of the whole bone at that part. The primary action is also, no doubt, of a low grade, and as such continues for some time, attended by exudation of a plastic character, which becomes both organized and transformed; but in the centre of the so-inflaming part, as is usually the case, the rise in action occurs; the suppurative crisis is reached there; and the matter, when secreted, is limited and confined by the condensed bone just formed—which barrier serves both a good and an injurious end. It is plainly analogous to the limiting fibrinous exudation in abscess of the soft parts, but is not alike salutary; for whilst it protects the surrounding parts from purulent infiltration and consequent disruption, it also prevents, from its density of nature, any thing like accommodating expansion before the accumulating pus, increasing greatly the pain and constitutional affection, and tending to aggravation of the original disorder. Unless relief be afforded, a more formidable inflammation will be induced throughout the whole affected part, inducing ulceration and necrosis, more or less destructive, with proportional aggravation of the constitutional disorder.

Sometimes the suppurative crisis is not preceded by a persistent minor grade of action, and in such cases there is little surrounding condensation—indeed such barrier may be scarcely appreciable. Tendency to diffusion is consequently great; rendering the progress of the case less protracted, but not less destructive.

The symptoms of this affection are very marked. Excruciating pain, constant, and rather on the increase than otherwise, is felt on one fixed spot, of limited extent; usually on the front of the head of the tibia. At that point the skin is red, but not tense, and only slightly swollen, if at all. Some increase of the pain results from firm pressure; but such increase is infinitely below what would accrue from direct compression of the part primarily inflamed. The superficial bone and soft parts have become involved in a minor grade of action, and it is from compression of these that aggravation of the pain occurs. As usual nocturnal exacerbation is also present. A sensation of weight and throb-

bing as well as of great pain, is felt and complained of by the patient in the centre of the bone; and to that spot, on which he can lay his finger, all his affliction is by him unhesitatingly attributed. No ordinary antiphlogistic treatment, however active, affords relief. Constitutional disturbance is severe, and of the inflammatory type; sleep is wholly denied, and not unfrequently delirium occurs. By continuance, the powers of the system are gradually exhausted; the fever consequently changes to the hectic type; and this may prove so urgent as to demand amputation. More than one mutilation has been performed above the knee, which should have never happened; perforation of the head of the tibia, and evacuation of a small abscess there, would have sufficed to resolve all the urgency.

It has been already observed, that usually, unless efficient relief be afforded, aggravation and extension of the original action occur, involving the whole bone at that part in suppuration, ulceration, and death. Sometimes, however, the progress is more gradual; absorption and ulceration occur in the parts surrounding the abscess; this slowly enlarges, and, obeying the general law, enlarges chiefly towards the surface; the surface is ultimately reached, the matter discharged, and the bone relieved; not unfrequently one or two small sequestra are discharged along with the matter. But this is both a painful and protracted process; occupying not days, but weeks; and ever liable to be merged in general inflammation and death of the bone. Even supposing that such accession do not occur, the constitutional disorder will be inevitably great; life may be endangered, or saved only at the cost of the limb.

Sometimes the abscess remains but little altered from its original state, for several weeks; seeming to have abandoned its acute character, shortly after its first formation; enlarging but little; yet occasioning continuance of symptoms of the most aggravated character, both generally and locally. On opening such a cavity, its pyogenic membrane is found unusually vascular and distinct.

The *treatment* is simple. Instead of the amputating knife and saw, at an advanced period of the case, we employ the scalpel and trephine at the beginning. The ordinary means having failed to arrest the inflammatory process, and the symptoms being sufficiently plain to convince us that a limited internal abscess has formed, we make a free incision over the marked spot, and there apply the crown of a trephine, perforating towards the interior. On reaching the cancellated texture, pus will probably begin to ooze by the side of the instrument; in withdrawing the trephine along with the laminated portion of bone which it has detached, a tea-spoonful or two of tolerably laudable pus escapes; and then, evacuation having been fully accomplished, the patient passes almost at once from the most cruel torments into placid repose. The flaps are replaced, and the wound treated on ordinary principles; all inordinate action quickly subsides, and the part ultimately cicatrizes firmly and permanently. Should the first trephining fail to detect the abscess, and the symptoms yet be most convincing of its presence, the instrument is to be reapplied, with hopes of a better success—as is well exemplified in a case detailed in LISTON'S *Elements*, p. 116. By such

comparatively simple procedure, both life and limb may be saved; an important fact, for which our profession stands indebted to Sir Benjamin Brodie. The constitutional symptoms—invariably severe—are obviated by the ordinary antiphlogistic means; but their best remedy, is by removal of the cause—evacuation of the abscess.

(c.) *Chronic Internal Abscess*.—This may result from the acute; action subsiding, and pus continuing to be formed not more rapidly than the surrounding parts can accommodate themselves thereto by expansion. Or the inflammatory process is chronic throughout. The laminated texture is gradually distended; the cancellated is either condensed, assisting to form the parietes of the cavity, or is removed by absorption, ulceration, or both; sometimes small sequestra become detached, and mingle with the fluid contents. The cavity steadily enlarges; its contents are purulent, but usually thin, commingled with the ulcerative debris, and, as just observed, often containing small sequestra; a distinct pyogenic membrane lines the interior; and the walls consist of the expanded laminæ of the bone, strengthened from time to time by recent osseous deposit. On making a section of a bone so affected, its laminated portion is sometimes found, notwithstanding much expansion, considerably thicker and more dense than in the normal state. At one point, however, attenuation of the parietes does take place, though very slowly: and there ultimately discharge may be effected.

The symptoms are like the action, of a chronic nature throughout; a dull indolent swelling forms gradually, with more or less affection of the super-imposed soft parts, and irritation of the system.

The treatment consists of perforation of the parietes at the prominent and thinnest part; the bistoury may be sufficient for this, alone, or the assistance of a small trephine may be required. The purulent contents are thus evacuated; and an efficient draining of them is ensured, by the establishment of a second and more dependent aperture, if necessary. Granulation and repair advance in the interior; by uniform support externally, from bandaging, centripetal contraction of the parietes is favoured; and thus, slowly, the cavity may fill up, the discharge cease, the swelling in some measure subside, and both symmetry and usefulness be at least partially restored. But not unfrequently, as can readily be imagined, the progress towards cure is interrupted, the part threatening to remain open, from failure of the reparative action. In such circumstances, stimulation of the interior by injections, as of sulphate of zinc, is likely to prove beneficial. And if these fail, a seton may be lodged temporarily, so as to arouse a fibrin-bringing action there, which, on subsidence of the true inflammation, may carry on repair with a renewed and more successful energy. If the cavity be large, and its parietes thin and superficial, the process of cure may be abbreviated by removal of a part of these by incision, and then dressing the wound so as to ensure contraction and filling up from the bottom.

There is an affection of bone termed *Spina Ventosa*, in some respects resembling chronic internal abscess—by the ancients supposed to be of a windy character, and hence, improperly, the term. Usually it is classified with tumours of bone, and may be considered analogous to the encysted tumour of soft parts. It consists of an equable expansion

of the laminae, forming a cavity in the interior, occupied by a fluid, not always purulent; sometimes only puriform, sometimes clear and glairy. The parietes, as the cavity slowly enlarges, are more and more attenuated; at some points they become only membranous, and ultimately the membrane too may give way; no osseous deposit accompanies the dilatation as in chronic abscess; for the morbid process is from the first independent of and unconnected with the inflammatory. The cavity is lined by a membrane, more of a serous than of a pyogenic character; and sometimes membranous septa subdivide, as in the multilocular serous cysts. The distinctive characters of the swelling thus are;—contents not always purulent; parietes simply expanded, and consequently attenuated; neither preceded nor accompanied by the inflammatory process; commencing, in the cancellated interior, by non-inflammatory formation of a cyst, which partakes largely of the serous character. The treatment is similar to that of chronic abscess. Puncture, satisfactory evacuation, external support, internal stimulation if necessary. Partial ablation may sometimes be expedient, as in the abscess; and sometimes entire removal is no improper practice. For example, the affection is not unfrequent in the phalanges of the fingers; and if one of these be wholly expanded into a large cyst, it is prudent at once to amputate that phalanx, instead of attempting the protracted, under such circumstances certainly imperfect, and probably abortive cure by incision.

(d.) *Scrofulous, or Tubercular Abscess of Bone.*—This is of indolent and chronic origin, liable to acute exacerbation. It is situated in the cancellated texture; in the bodies of the short bones, or in the articulating extremities of the long. The first step is the deposit of tubercular matter in the cancelli, either by perversion of simple nutrition, or accompanied by a low grade of the inflammatory process. Such deposit having accumulated in some quantity, asthenic inflammation supervenes, spontaneously or by external injury; the tubercle crumbles down, and becomes mixed with a non-laudable purulent fluid. And this matter may be either limited by an imperfect pyogenic membrane, or become diffused by infiltration; most frequently, the abscess is of the diffuse character. According to the site, either the general surface is approached, and the tubercular debris, with pus, thence discharged; or the neighbouring articular cavity is opened into, and by such irruption grave inflammatory action is excited therein. But neither of these events, it is plain, can occur, without serious injury having been first done to the cancellated texture in which the abscess originated.

The symptoms are, first, uneasiness and weight, rather than pain, deeply seated in the bone; increased somewhat by pressure, and considerably by motion; and occurring in a patient of an obviously strumous habit. Enlargement of the bone then takes place at that part, with increase of the uneasy sensations: the super-imposed soft parts become œdematous, and the skin assumes a bluish colour. On occurrence of the suppurative crisis, enlargement becomes more rapid; pain increases, but yet is comparatively dull; shivering takes place, and the system thereafter sympathizes more or less. When the surface is approached, fluctuation and pointing may present themselves, unless in-

cision be premised ; and, on opening taking place, the usual characters of the scrofulous sore are exhibited, with the addition of a foul ulcer of bone at the bottom of the cavity. When, on the other hand, an articulation is opened into, violent aggravation of both local and constitutional symptoms follows, as will be afterwards described.

Treatment should be mainly prophylactic. By rest, fomentation, and attention to the general health, it is our object to limit the tubercular deposit and delay its suppuration. When this has occurred, we have little or no power of controlling the untoward progress. All that we can do, is to evacuate matter by incision, so soon as its presence has been detected—seldom until it has appeared in some quantity in the soft tissues—mitigating meanwhile both local and general symptoms, as they arise.

(e.) *General Suppuration of Bone.*—The abscess is neither external nor internal, but diffuse, pervading the whole thickness of the bone, and invariably acute ; the result of intense general osteitis. The bone, or portion of bone, so affected, usually dies ; and may be said to be bathed in a profuse secretion of pus, which not only burrows under the periosteum, but lodges also in the general soft parts, ultimately, nay rapidly, making its way to the surface ; in fact the case is one of acute necrosis. The ordinary symptoms are, shivering ; violent, deep-seated pain, constant, and increasing ; great swelling of the limb, obviously of inflammatory origin ; redness of the integument, as if erysipelatous ; constitutional disorder, severe, and of the sthenic inflammatory type. Matter forms and is discernible in the soft parts, deep, in contact with the bone ; it approaches the surface at one or more points, and is discharged by either an artificial or spontaneous aperture. Soon thereafter the inflammatory fever may pass into hectic. The acute stage of abscess has gone by ; the chronic stage of necrosis has become established.

The treatment consists in active and early antiphlogistics, both general and local, in order to prevent suppuration. When matter has formed, early and free incision is required, not to prevent necrosis—for that is impossible—but to limit its extent, and favour the natural process of cure.

III. ABSORPTION OF BONE.—This is more or less connected with perverted vascular action, but altogether independent of true inflammation.

1. *Interstitial.*—This may affect the whole of a bone, in conjunction with deficient nutrition ; and the result is wasting or atrophy. Often it may be termed an indirect and remote consequence of inflammation. In what is ordinarily termed “white swelling” of the knee-joint, for example, wasting of the bones of the limb, more especially of the femur, is almost an invariable concomitant of the confinement to a sedentary or recumbent posture. This state of matters is to be obviated by attention to the general health ; but, chiefly, by cure of the articular disease, and consequent resumption of the wonted function of the limb.

A more important surgical affection is interstitial absorption, affecting a part of a bone ; converting its dense laminated portion into a cancellated texture, and ultimately imparting to its surface a worm-eaten appearance. This is a slow, insidious process, non-inflammatory ; ob-

scurely marked by dull uneasiness or aching in the part, œdema of the super-imposed soft tissues, and lividity by passive congestion of the integument; the part feels weak; when used, it becomes soon the seat of pain as well as of fatigue, and at the same time the swelling is somewhat increased. In itself it is important as entailing change of structure, and impairment of function. But it derives its chief interest from being the precursor of a much more formidable disease—caries. The metacarpal bones are often so affected. The treatment consists of attention to the general health, rest, and counter-irritation; the last gentle, but perseveringly maintained until the symptoms have satisfactorily disappeared. And then a roborant and soothing plaster may be for some time worn with advantage—as the emplastrum opiatum, spread on thick leather.

2. *Continuous*.—This is the result of pressure, sufficient to stimulate the absorbents to an increased, and probably perverted action, but not intense enough to rouse the blood-vessels to assumption of inflammation. There is gradual loss of substance; and so a cavity may be formed in the bone, even to a large extent, slowly, and almost without pain. After death, it may seem the result of ordinary ulceration; but pathologically it differs widely from this; there is no inflammation, no formation of pus, no crumbling down and solution of the particles—in short there is no true ulceration, nor any of the symptoms which ordinarily accompany and indicate this inflammatory product. For the maintenance of such simple structural change, exclusion of atmospheric influence is essential; admit this, and inflammation is the certain result of the stimulus on the part, greatly predisposed to morbid action; pain and rapid destruction of texture supervene, by ulceration; and purulent fluid is thrown out in abundance.

Examples are afforded by gradual compression of bone from aneurism, chronic abscess, or solid tumours—slowly enlarging. The affection may persist of its original simple nature; more frequently it becomes merged in the more rapid destruction by true ulceration; for all that is necessary to such supervention is external injury, and admission of atmospheric influence, or sudden increase of the compression.

There is but one mode of treatment—removal of the cause, pressure; by evacuation of the abscess, cure of the aneurism, excision or discussion of the solid tumour.

IV. *ULCERATION OF BONE*.—This may be simple and tractable—Ulcer; or peculiar, and difficult of cure,—Caries.

1. The *simple ulcer* of bone, is the product of true inflammation, as in the analogous condition of the soft tissues. Inflammation is invariably its direct cause; often pressure is the inducing, but more intensely and suddenly applied than in the production of continuous absorption; and although atmospheric influence is not essential, still it is very favourable to the process. As a soft texture may inflame, suppurate, and ulcerate, so may bone; the inflammatory process originating in and being mainly limited to the ulcerated part. Not unfrequently, however, the site of ulcer is not that which is primarily, but that which is secondarily involved; abscess, occurring either by osteitis, or by inflammation of soft textures in the immediate vicinity of bone, compresses a

portion of bone not originally inflamed, and so induces its molecular destruction. Such pressure may come from without or from within; the abscess may have formed in the soft tissues, and cause ulceration in the surface of the bone; or suppurative ostitis having occurred in the cancelled interior, and the pus making its way outwards by ulcerative action, in obedience to the general law, a chasm in the bone necessarily results.

The destructive process is simple, like its analogue in the soft textures. So long as pressure and inflammation continue, ulceration advances with more or less rapidity; but on their removal, it also ceases, and the process of repair succeeds. The healing process is not entirely similar, however, as can readily be supposed. There is formation of new matter, as in the healing ulcer of the soft parts, and this new matter is converted into bone, constituting what may be termed osseous granulations; by these the surface of the healing sore is more or less copiously studded; but the supply of such new material is far from being so abundant as in the cutaneous sore. The surrounding bone, being an inelastic texture, does little towards diminution of the chasm by centripetal movement; something however is effected by absorption. While the excavated surface is scantily throwing out new osseous matter, interstitial absorption is advancing in the margins, which are, as it were, bevelled off thereby; and, ceasing to be abrupt, slope gradually towards the central depression. Thus, partly from elevation of the excavated surface by reparative action, partly from levelling of the surrounding margins by absorption, the cavity comes to be gradually diminished; and the super-imposed soft parts, meanwhile busy in bringing themselves into a state suited to granulating repair, now coalesce with the osseous granules beneath, and interweave hard texture with soft, in a fibrous substance, which, ultimately skinning over, gives a firm, depressed, solid, white, permanent cicatrix.

Sometimes the soft parts heal by themselves, independently of the bone; filming over while the ulcer beneath is yet unclosed. The cicatrix then is elevated, evidently unconnected with the bone, livid, soft and painful; certain soon to be undone by re-accession of the inflammatory process, disclosing the ulcer beneath, perhaps wider and deeper than before.

Ulcer of bone, though originally simple, and well disposed to heal, may, from its extent, or by re-accession of inflammatory and ulcerative action—and consequent vacillation in its progress—degenerate into a weak or indolent condition, tardy and inefficient in repair—as happens, under similar circumstances, in the soft parts.

Treatment is conducted on principles precisely similar to those which regulate that of the cutaneous sore. Rest, water-dressing, and anti-phlogistic regimen—not forgetting removal of any obvious cause, at the outset—during the inflammatory and ulcerative stages; then water-dressing, medicated so as to gently stimulate, external support by uniform bandaging, and maintenance of the vis vitæ by suitable regimen, not antiphlogistic, so as to ensure activity of repair.

2. *Caries*.—This may follow on the simple sore; more frequently it is original. It is something more than a weak ulcer of bone; it is

something less than a malignant or cancerous sore, as it is too often designated. With many, there is a culpable laxity in the use of this term, by applying it indiscriminately to all breaches of continuity of bone of whatever kind. I shall endeavour to define the state of matters to which the term caries is truly applicable, and shall use that term only to denote that condition; remembering the just saying of Mr. Pott, how "clear and precise definitions of disease, and the application of such names to them as are expressive of their true nature, are of more consequence than they are generally imagined to be. Untrue and imperfect ones occasion false ideas, and false ideas are generally followed by erroneous practice."

Caries is a breach of continuity in bone, of an altogether peculiar kind, of itself almost incapable of cure, yet not in any degree partaking of truly malignant action. It is preceded and accompanied by interstitial absorption, as formerly observed; cancellated texture seeming to be its proper nidus; and degeneration of laminated bone into this state seeming to be essential to its accession, in those parts where cancellated texture does not naturally exist. The margins of the cavity consequently have not the abrupt and firm character of the simple ulcer, but are soft, spongy, and worm-eaten in appearance. The surface of the cavity is sometimes of a uniform level; more frequently it is unequal, deep at one point, and comparatively shallow at another. It has no adequate power of reparation; it is either open and uncovered, as if either inanimate, or yet undergoing disintegration—a probe passing crumbly into it, as if into soft decayed woody fibre; or it is invested by tall, pale, fleshy granulations, which seem altogether incapable of completing transition into bone. The ulcerative action is rather chronic than acute; sometimes the bone is extensively and rapidly destroyed; more commonly, destruction is slow and gradual, even when great; not unfrequently but a slight extent of the bone's surface is involved, even in cases of old standing. The whole of a small bone, even the whole of a chain of small bones, or all the articulating extremity of a long bone, may be attacked; or a thin external portion alone may suffer. A thin, fœtid, purulent discharge, often bloody, always acrid, usually more or less mixed with ulcerative debris, and often containing small detached sequestra, exudes in considerable quantity; the corresponding soft parts are swollen by infiltration, and broken up by suppuration, and one or more apertures exist in the integument, presenting the characters sometimes of the weak, sometimes of the scrofulous, sometimes of the irritable, sometimes of the inflamed ulcer. A probe, passed through these apertures, reaches the bone, and is found to sink into it; readily, with the application of little or no pressure, if the surface be uncovered; but not without pressure, if the investing firm granulations exist, as very frequently is the case. In the use of the probe, this must be borne in mind; otherwise fallacy of diagnosis is not unlikely to be incurred. Sometimes the probe may be freely used, and little pain ensue; but more frequently even its lightest movement causes much suffering, and considerable hemorrhage of a dark oozy nature; both pain and bleeding being due to the soft parts,

rather than to the bone. Usually there is smart pain in the part, even independently of external interference.

The diseased portion may be conveniently considered as consisting of three parts; the central, the ulcerous cavity; a circle exterior to this, affected by interstitial absorption; a third, beyond, consisting of comparatively sound bone, undergoing a low grade of vascular action, of the sthenic character. The two interior portions are incapable of efficient re-production or repair; the external is busy, in, as it were, atoning for their deficiency, by the throwing out of new osseous matter, sometimes in great abundance. Thus the carious cavity is surrounded first by spongy worm-eaten bone, and more exteriorly by osseous spicula or granules, forming a hard irregular ridge, sometimes but slight, at other times extensive. It is not meant that such is the arrangement in all cases, but only in the majority; in some the ulcerous margin terminates abruptly on the region of osseous repair. Sometimes necrosis is engrafted on the ulcerative process; and in the cavity may be found dead portions, either of cancellated or laminated texture, partially adherent, or altogether loose as sequestra.

The system invariably suffers to a greater or less extent; and the disorder is of the asthenic type—constitutional irritation. Very often the patient has been for some time manifestly cachetic, previous to accession of the local mischief; if not, symptoms of a hectic character are not long in supervening—all the more early and formidable if the caries implicate an important articulation.

Caries may be *simple*, as just described; or it may be of a *scrofulous* or *tubercular* character. In the former case it is unattended by any peculiar deposit. In the latter, it is both preceded and accompanied by deposit of tubercle in the open texture of the bone; originating, in fact, in the morbid condition formerly detailed as constituting the scrofulous abscess of bone. First there is the tubercular infiltration of open texture, either originally cancellated, or rendered so by interstitial absorption; then disintegration and suppuration of this; from the ultimately open condition of the abscess, the state of ulcer necessarily results; and the cavity of the ulcer is more or less occupied with tubercular masses of a lardaceous character. The soft parts present the usual appearances of the scrofulous sore; and the system, both before and during the progress of the local disease, shows the ordinary signs of the strumous cachexy, latterly aggravated by more or less of hectic; during the suppurative stage, irritative fever is not unlikely to be present.

Causes.—As already stated, the disease may be primary; or secondary, an originally simple ulcer having so degenerated. Sometimes the bone is not the texture first involved; infiltration and suppuration, tubercular or not, may have occurred in the soft textures, and thence diseased action may have extended to the neighbouring bone; or an intractable ulcer of the soft parts, may come to implicate the subjacent osseous structure,—as in lupus. By some, the affection of bone which follows on the truly malignant ulcer or tumour of soft parts is termed caries, but unjustly; it is a truly malignant or cancerous ulcer, just as different from true caries as cancer is from the simply weak or irritable

sore. In the tubercular caries, scrofula is of course to be considered as the predisposing cause; and slight external injury may serve for the exciting. Syphilis may induce caries of the cranial and other bones; the poison often seeming to enact the part of both predisposing and exciting cause; and the same may be said of mercury, perhaps with greater truth—at least in those cases in which that mineral has been given both sakelessly and in profusion. An unfortunate conjunction of the two poisons—mercurial and venereal—in a scrofulous system, is the parent of the worst, and not least frequent, forms of the disease.

Treatment.—Prevention is obviously the paramount indication. With this view, if the symptoms of interstitial absorption be present, our attention will be directed to the arrest of this by rest, counter-irritation, and constitutional care. If a simple abscess or ulcer occur on the surface of bone, it will be our object to effect the healing of this as rapidly as possible, in order to prevent degeneration. When merely osteitis is present and demands our aid, we shall treat it actively yet warily; actively, in order to arrest the inflammatory process, ere yet the untoward results of suppuration or ulceration have occurred; warily, avoiding exhaustion of the system, and still more the poisoning of it, by excess of mercurial and other active antiphlogistics—a state favourable to the occurrence of destruction of bone. And seeing that the local disorder is usually so much connected with taint of the system, our attention will be throughout directed towards the constitutional care, in connexion with both prevention and cure.

When caries has occurred, the indications of local treatment are abundantly simple. We are to take away the two portions which are incapable of repair—the interstitially absorbed, as well as the truly ulcerous—and leave a solid foundation of normal texture, not only capable of, but already engaged in, the business of efficient restoration. Afterwards the part is to be treated as a simple ulcer; our anxious care being directed to speedy, yet efficient and certain closure, lest renewed degeneration supervene; not resting satisfied with a blue, elevated, soft and spongy cicatrix; but insisting on the establishment of one which is firm, white, depressed—plainly incorporated with the bone. For effecting the removal, cutting instruments are infinitely preferable to escharotics, in all situations where excision is practicable. But, as a general rule, no operation of any kind should be performed on the bone, unless the adjacent and super-imposed soft parts are in a quiet state. They may be undergoing the acute inflammatory process; they may be the seat of acute suppuration, of acute ulceration, or of both; and removal of a portion of bone imbedded in such soft parts is almost certain not only to prove futile as a means of cure, but actually to aggravate and extend disease. The then carious portion of bone may be taken away, but ulceration, instead of reparation, is certain to ensue, and by rapid degeneration the carious condition is renewed; or a more intense and general osteitis is kindled, and the partial caries is merged in general necrosis. And even supposing none of these untoward events to occur, still the time of operation were inexpedient, as causing an unnecessary and therefore an unwarrantable amount of pain.

The soft parts being already quiet, or having become so under suit-

able treatment, free incision is made through them, so as effectually to expose the diseased portion of bone—previously tolerably well explored by a judicious use of the probe. The extent of the doomed parts having been satisfactorily ascertained, their thorough removal is then to be accomplished by the saw, trephine, bone-pliers, or gouge, as circumstances may render expedient. The articulating extremity of a long bone, for example, may be readily taken away by the common saw, or by a smaller straight-edged instrument. In a flat bone, such as the cranium or scapula, the trephine may be more convenient. And in many situations, when either the previously mentioned instruments are inapplicable, or when by them we have already taken away much but cannot remove all, our object may be gained by an instrument closely resembling the carpenter's gouge; firm, well tempered, and of a sharp edge; used lightly, so as not to crush but cut; and yet used determinedly, so as to ensure ablation of all the texture prone to renewal of ulceration and incapable of repair.

Escharotics in some cases are employed; as for example, when the patient resolutely objects to any other mode of removal; or when cutting instruments have been used, and yet a border of suspicious character remains; the extinction of such a suspected part may sometimes be conveniently enough intrusted to cauterization. The actual cautery may be applied; but unwisely. It effects too much. The carious part is at once and satisfactorily killed; but, as in all severe burns, the texture immediately surrounding the eschar, though escaping with life, has its vitality very much impaired, and is more prone to disintegration than repair. The potential cautery is infinitely preferable; it destroys the diseased part, just as effectually, though perhaps with less rapidity; and at the same time the immediately adjoining parts do not in anywise suffer, but at once institute a healthful line of demarcation for removal of the dead part, and are well able to commence at the same time a sthenic process of reparation. The preferable forms of potential escharotic are the red precipitate of mercury in powder, and the chloride of zinc made into a paste; the latter is the more generally useful. Application is made with intensity deemed sufficient to ensure death of all the suspected part; the escharotic is then removed; the whole wound is filled gently with lint; and such dressing is continued, covered perhaps by a poultice to mitigate vascular action, until separation of the eschar has occurred; the bone's surface is then treated as a simple ulcer, with two paramount objects in view—speedy healing of the sore so as to obviate degeneration, and a healing from the bottom, so as to ensure the attainment of a permanent and healthy cicatrix.

Certain parts of the skeleton are liable to caries, and not accessible to either knife or caustics; as the knee and hip-joints, and the bodies of the vertebrae more especially. In these, the main reliance for cure must be placed in Nature; the surgeon is qualified only to assist in the procedure. But as, under such circumstances, ordinary indications of cure cannot be carried out—or at least can only be slowly and imperfectly fulfilled—prognosis is unfavourable. It is still essential that the carious surface shall be thrown off, and a healthy foundation for repair obtained. This can only be accomplished by an effort of the part itself;

by ulceration, crumbling down the carious and unnaturally cancellated part, and leaving the surrounding normal texture unattacked; ceasing when it comes there, its task having been accomplished, and giving place to the reparative effort already there begun. Or the ulceration may be accelerated, or at all events mixed up with a more continuous death of the unprofitable part—necrosis. Such destructive process, especially that by simple ulceration, may advance leisurely and quietly, without any communication with the external atmosphere. One of two events may then occur; the skin may continue unbroken, the purulent matter becoming absorbed, as well as the molecular debris of the bone which it then holds in solution; and this, it is plain, can only happen when the disease is of very limited extent, and the process altogether chronic in its nature. Or the abscess, with its contained debris, and perhaps sequestra, finds its way to the surface in the usual manner, and is thence discharged. But it is in the early open condition that the process is likely to advance most favourably; atmospheric influence being favourable to acute—and consequently efficient—ulceration, while at the same time a ready exit is obtained for the useless, and otherwise fast accumulating discharge.

The auxiliary treatment, afforded by our art, in suspected disease of these inaccessible parts, is, in the first place, to prevent the occurrence of caries if possible, and obtain simple restoration to health; by attention to the general health, rest of the part, and counter-irritation. When caries has doubtless begun, and the action is slow, as well as the apparent extent of the disease limited, we do little more than abide the working of nature, watching over the general health, and maintaining for the affected part a complete immunity from motion; in the hope that disintegration will prove but slight, and opening of the surface be unnecessary, that the ulcer, freed from its carious surface, may either simply cicatrize; or, inosculating with an opposed part in like condition, effect a compromised cure by ankylosis. When the diseased surface is obviously large; when in consequence the suppuration must be profuse, the destructive ulceration extensive and sustained—we cannot too soon effect an aperture of communication with the exterior; which may at once expedite ulceration, abridging the process of destruction, as well as rendering it more likely to effect the object in view, and permit free evacuation of the suppurative and ulcerative results. We keep such a wound open and dependent; the vascular action which necessarily follows on its infliction, we anxiously watch, and if necessary subdue; and the powers of the general system are husbanded and maintained.

It can be readily understood, however, that in but few cases a successful issue is to be expected for this natural process of cure. Ulceration may extend, and the original carious surface so be destroyed; but most likely only to disclose a continuance of the carious state; a sound portion of bone, fit for repair, may be never reached; for, absorption, changing structure, and impairing power, may prove still the precursor of the ulceration. The system may be gradually worn out by the suppuration and its hectic. Or acute inflammatory action may seize on the part; as is not unlikely to happen on the establishment of the aper-

ture for discharge ; irritative fever is lighted up in consequence, and this may more rapidly exhaust the patient.

The foregoing points of practice, as to the surgically inaccessible sites of caries, are obviously illustrated by reference to lumbar abscess, originating in caries of the vertebræ ; morbus coxarius ; and carious ulceration of the articulating surfaces composing the knee joint.

V. DEATH OF BONE, OR NECROSIS.—This may be the immediate result of external injury, the bone at once parting with its vitality ; as in extreme burns, in which all the component textures of the limb are instantly converted into an inanimate eschar. Much more frequently it is the indirect result of injury, the bone perishing by an overpowering inflammation. When unaccompanied by any other form of disease, it is said to be simple ; compound, on the other hand, if combined with caries, or attendant on fracture, as not unfrequently happens. When consequent on wound or other external injury, it is called traumatic ; idiopathic, when originating without any appreciable exciting cause ; often, in the young, a bone is acutely inflamed without any apparent reason, rapidly becomes the seat of suppuration, and dies to a greater or less extent.

The extent of necrosis is very various. A mere leaf or scale of bone may perish on the external surface ; and this is termed *Exfoliation*. A larger and considerable portion of the laminated texture may die ; or this may retain its vitality, while the cancellated interior perishes ; the dead portions, or *sequestra*, are called external and internal accordingly ; and like terms are applied to the necrosis. Or the whole thickness of the bone dies in one continuous mass, and the disease is then said to be general. This general necrosis varies much in its extent ; sometimes but a slight portion of a long bone so perishes and is thrown off, sometimes several inches, sometimes nearly the whole. But it is seldom that the entire bone suffers ; usually the articulating extremities remain, the line of separation occurring there ; a fact which has been long recognised, and that gladly, by the surgeon, as compassing two good ends ; first, the process of reproduction or repair is thereby facilitated ; second, the joints are saved from purulent irruption, and the inflammatory destruction which would necessarily follow. While the cancellated tissue of bone is prone to caries, necrosis is of more frequent occurrence in the dense and compact portions of the skeleton.

The *process* of necrosis may be conveniently divided into stages.—1. The bone, or portion of bone, inflames. Those cases in which the bone is directly killed by external violence, we have already stated, constitute the minority. In considering the process, therefore, it is right that we should describe it as it most frequently occurs ; and accordingly we begin with inflammation. This, as also before observed, may be the result of external injury, as wound, bruise, or fracture ; or it may be of apparently spontaneous origin. It may terminate in local death, either in consequence of its own intensity, or on account of this being associated with diminished power in the part affected. The associated cause is more frequent than the single, in the cases of traumatic origin ; the injury not only kindling the osteitis, but at the same time diminishing the vital power by which it is to be opposed. In wounds

implicating bone, the periosteum is often removed; this obviously impairs power in the part so stripped, which, accordingly, on the supervention of osteitis, is predisposed to die. But it by no means follows that because a portion of bone has been denuded of its periosteum, and that even rudely, it must inevitably become necrosed; acute osteitis occurring, necrosis is imminent, but not inevitable; the part may yet retain a sufficiency of power for a successful struggle, and live. But if the periosteum, and the membrane lining the interior—sometimes termed endosteum—both perish or be removed at corresponding points, death of the portion of bone so isolated, cut off from its vascular supplies, is then indeed certain; and but little, if any, osteitis is necessary to that result.* When exposed bone retains its vitality, it is of a brown hue, sounds dull on being struck, emits blood when rudely handled, and is covered by a self-secreted fluid; on the contrary, if it be dead or dying, its colour is white, it is resonant when struck, it is dry, unless when moistened by purulent secretion from the surrounding parts, and does not bleed when touched however rudely. Such signs it is useful to remember, as not only auxiliary to diagnosis, but bearing strongly on the mode of dressing. However it must also be well understood, that a bone stripped of periosteum, at first may show all the usual indications of retained vitality, and yet whiten and die ultimately; and also that an exposed portion of bone may become white, sonorous, and apparently non-vascular, shortly after the infliction of the injury, and yet recover with the thinnest possible exfoliation. In the latter class of cases the process of renewed and increased vascularization, in a part previously exsanguine, may often be seen beautifully exemplified.

2. The bone dies. The changes just detailed, as indicating death of bone, occur sometimes very rapidly, being completed in a few hours; in other cases, the event may be protracted for several days, as if life were gradually and reluctantly relinquished. If previously, during the condition of simple osteitis, the periosteum were adherent, it is now completely detached, and purulent secretion is interposed between it and the bone.

3. The dead portion is separated from the living. The death, or second stage, is often rapidly completed, and is never protracted. This, the third, is invariably tedious and slow. The mode of detachment is similar to that of sloughs of soft tissue; but very different as to the time employed; a slough separates in a few days; but weeks and months may elapse, and the detachment of the sequestrum may still be incomplete. The extent of the necrosed portion is indicated by its white, sonorous, insensible, and non-vascular characters; and these it retains throughout the whole process, seeming as if it were a macerated portion of skeleton; the only change likely to occur being a darkening of its hue, by exposure to atmospheric influence, or to chemical action from contact with the purulent secretion. But around this unchanging

* A marked sympathy of function has been observed between the periosteum and endosteum; when the former has been destroyed, the corresponding portion of the latter becomes peculiarly active, often causing an obliteration of the medullary canal at that point by a deposit of recent bone; after injury to the endosteum similar sympathy is evinced by the periosteum; in fact, destruction of either membrane involves an increased duty and activity of production in that remaining.

portion, and more especially in the parts immediately continuous with it, there is great activity; the colour is red or dark brown, evidently from increased and increasing vascularity; the slightest touch is both painful and followed by blood, of a florid arterial hue; a clear fibrinous secretion is slowly exuding; and the gentlest touch of the probe or finger nail plainly indicates a softening of that part, by removal of a large proportion of its earthy matter. In short, while the dead part is undergoing no change, unless perhaps a variation of hue, the living parts all around are softened and increased in vascularity, busy in carrying on an inflammatory process of a truly sthenic kind. This quickly terminates in suppuration and ulceration; and so a sulcus is begun, which, by gradually deepening, ultimately—but not till after a long time—detaches the dead from the living, resolving the former into the condition of a loose sequestrum. As in the similar process in soft parts, ulceration does not proceed alone; reparation follows quickly on its heel; and no sooner has the primitive sulcus been formed by the action of destruction, than osseous granules begin to spread, by the action of repair, from the margins which the ulceration has only just left. Now, the stage of separation commences immediately on the completion of that of death; and the former is not well begun, ere the work of reproduction has laid its foundation. Therefore it may be said, so wise and provident is Nature, that the necrosed part is scarcely yet dead, ere the formation of its substitute has been duly set in progress. The separation, it has been stated, is invariably slow; and it is well that it is so; for, the formation of new bone, to supply the place of the old which has perished and must be thrown away, is also a process inevitably tedious, even although early begun; the two—separation of old and reproduction of new—advance *pari passu*; and it is surely a most beneficial and wise arrangement which has decreed that the one shall not be completed leaving the other much imperfect; that the portion of old bone shall not be loosened and cast away as a useless thing, until an efficient substitute has been prepared to occupy its place and function. During the process of separation, or ulceration, there is necessarily a constant, and often a profuse secretion of pus; this is discharged externally through apertures in the soft parts already existing; or it burrows and accumulates at new points, where free and dependent incision soon comes to be demanded. The discharge is usually thick, and yellow—laudable in appearance—charged with more or less of the ulcerated debris, and invariably possessed of an oppressive and peculiar fætor—a sickening heavy odour, which, when once felt, can ever after be readily recognised—a sure sign of necrosis.

4. Separation of the dead portion is completed. The ulcerative action has encompassed it on all sides and beneath; it is now loose, unless where hemmed in by exuberant formation of new osseous matter above and around, as is not unfrequently the case—a redundancy of reparative effort by no means to be complained of, being obviously by much the safer side on which Nature may err—and is to all intents and purposes a foreign substance; detached from the living; of no farther use, and no longer recognised as a part of the living economy; on the contrary, a noxious body whose presence is resented by continual suppuration

and excitement in the living parts, and which cannot then be too soon extruded from the system.

5. The dead portion is extruded. As in the case of threatened lodgement of any other foreign substance, suppuration is the main agent in this. By the pus, the loose sequestrum is, as it were, floated to the surface, and there exposed. And if Surgery be either slothful or altogether in abeyance, Nature may even complete the task of final discharge, though slowly and painfully and with much exhaustion to the general frame. But another agent is also at work. By the ancients it was supposed that the dead portion was simply pushed off by granulation from beneath, ere yet it was detached from its continuity with the living texture. Such we have seen is not the case. It is separated by a very opposite process; not formation of new matter, but disintegration of the old. But to this disintegration of the old, as a means of separation, formation of new as a means of repair almost immediately succeeds. This reparative action is not limited to the margins and surface of the sulcus, but follows the ulceration throughout its whole track; so that when the dead part is completely detached and loose, it is virtually borne on a bed of granulation, which, continuing to spread upwards in the reproductive effort, obviously assists in carrying outwards the sequestrum and favouring its approach to the surface. At the same time, be it ever remembered, this and every other effort towards expulsion may be fully counteracted by retention of the dead and detached part, in consequence of a tight embrace of the living substitute which has formed over and partially incased it.

6. Reparation is completed. This we have already seen begins at the same time as the process of separation, and is originated by the old bone at the living margin of the ulcerative sulcus. From this point it advances, consentaneously with the process of separation, in two parts, a deep and superficial; the former, following close in the track of the ulceration, consists of osseous production from the living bone beneath the loosening sequestrum; the other, begun by bone, but apparently carried on by periosteum, invests the dead part on its exterior; gradually shelving over and incrusting it, as bark does a tree, and hence often termed the *cortical* portion of the *substitute*, or new formation. Wherever the periosteum is entire, there the formation of this cortical bone proceeds, continuously with that which has come in gradual extension from the parent shaft. But in several places it is probable that periosteum is deficient. So soon as the part died, its periosteum, as formerly stated, became detached from it, and pus was interposed. This pus must sooner or later find its way to the surface; and for this purpose solution of continuity is made in the investing membrane either by the knife or by ulceration, more frequently by the latter. Such apertures remain open, not unfrequently widen, and through them the pus continues to be discharged. The cortical formation, begun by bone, and apparently maintained—nay, chiefly effected—by periosteum, having reached such an aperture, has its continuity interrupted; where the membrane is deficient, so is the osseous shell; it passes round the margins, and an aperture is formed in the newly constructed case of bone corresponding to the opening in the periosteum. In fracture,

without suppuration, ossification we shall find begun by bone, continued by periosteum, and where that is deficient sustained by the surrounding parts which assume periosteal character and function; and consequently the incasement of bone under such circumstances is continuous. But there is no substitute for deficient periosteum; the surrounding soft parts have suppurated, and are themselves reduced to the condition of an aperture or canal for discharge of matter. This, however, is not a disadvantage; on the contrary, were the deficiencies of periosteum invariably supplied by adventitious structure of similar capabilities, the cortical formation would also invariably be continuous; the purulent matter would be denied an outlet, and all the pains and dangers of acutely accumulating and deeply seated pus would inevitably ensue. As it is, the deficiency of periosteum is not supplied; the cortical formation is at that point proportionally defective; and a permanent aperture, termed *cloaca*, results; communicating with the cavity which contains the sequestrum, on the internal aspect, with the suppurated aperture and canal of the soft parts exteriorly, and of the greatest use in securing efficient discharge of the purulent or other fluids. The external orifice of this discharging canal is usually callous, and of an elevated or pouting character; it is termed a *papilla*, and in every case where necrosis is at all extensive, there are not one but several such purulent canals, through the *cloaca* in connexion with which a probe may be made to impinge on the sequestrum. Through these apertures the condition of the dead portion may be from time to time ascertained; and so soon as it has become loose, it is through these apertures, enlarged if need be, that it is removed. So soon as it has been discharged, the two portions of the new osseous formation tend to coalesce, and so complete the construction of the dead bone's substitute. Hitherto, the sequestrum, as a foreign substance, was interposed between; now, the cortical frame, descending, comes ultimately to mingle the soft osseous granules of its internal aspect with those which are rising from the subjacent stratum of original bone. And so, somewhat as in chasm of the soft parts, the cavity previously occupied by the sequestrum, comes ultimately to be filled up, partly by the continued formation of new matter, partly by the mutual approach of the parts already formed. Suppuration ceases gradually; the *cloacæ*, no longer useful, are slowly filled up—or at least diminished—by new formation from the osseous margins; the whole part becomes firmly consolidated; and the inflammatory process altogether subsides. Before removal of the dead part, there was much bulky swelling of the limb, partly from the infiltrated condition of the soft parts, partly from the elevated position of the cortical bone. But now this seeks a lower level; besides, the absorbents so act as to condense and strengthen the new texture, rendering it more efficient as part of a column of support; and at the same time, the inflammatory process having in all its parts and every where abated, absorption is not idle in the super-imposed soft texture. In consequence, the unseemly swelling gradually disappears; and ultimately the part has both its function and its symmetry more or less completely restored.

An analogy plainly exists between reproduction of bone, and repara-

tion of loss of substance in the soft parts. The granulations which fill up the latter chasm, and, restoring all to one level, permit the formation of new integument, are analogous to the new osseous production from the parent bone; the cuticular investment, gradually extending from the circumference, to effect cicatrization, has for its analogue the cortical formation beneath the periosteum; which, covering in the deep substitute, may be said to effect its cicatrix.

Hitherto we have been speaking of the restorative process as occurring in a case of partial necrosis; an external portion only having perished; having living bone on one side, and periosteum on the other. Events are very similar in the other forms. When the necrosis is internal, a part of the cancellated texture only having died, reparation follows rapidly on extrusion of the sequestrum through an aperture, formed by ulceration, in the laminated portion—which opening is, like the corresponding interruption of continuity in the cortical portion, termed a cloaca—and is effected entirely by the surrounding living bone, which constituted the parietes of the cavity in which the sequestrum lodged. At first the new structure is of preternatural density; but by continued action of the absorbents, continuity of normal texture is ultimately re-established. When the internal sequestrum is small, the original inflammatory action having been but limited, and the present suppuration being but slow and slight, perforation of the bone for discharge of both pus and sequestrum may be a very tedious process; meanwhile, by the continued presence of the foreign body within, an ostitis of a minor grade is permanently maintained in the vicinity, and perhaps to a wide extent; in consequence, the bone may become much enlarged, as well as condensed in its structure, and often is roughly nodulated on the exterior. A somewhat similar change of the shaft of a long bone follows on the formation and lodgement of a large internal sequestrum, in connexion with which a cloaca may have been early formed, but too minute to admit of spontaneous extrusion.

When a portion of bone including its whole thickness has perished, the process of separation advances in the usual way; as also the commencement of reparation by osseous production from the living margins of the sulcus. The osseous production, begun by the bone, is continued by the periosteum, gradually shelving over the whole exterior of the dead portion. The sequestrum, when loose, is dislodged—perhaps by the osseous granulations around—from its rectilinear relation to the living shaft; it then gradually seeks the surface; and thus both room and opportunity are afforded for the parent bone, on each mutilated aspect, to send forth its reproductive formation. After extrusion of the sequestrum, the cortical portion falls inwards, as usual, and, coalescing with what is being formed by the old bone, a solid and efficient substitute is ultimately obtained. Still the restoration of the bone's continuity is due to both bone and periosteum; still the former texture takes the initiative in the process; and the two formations, from periosteum and bone, must advance together, in harmonious co-operation. Complete reproduction, however, is not to be expected in all cases. If a small portion only of the entire thickness perish—say half an inch, or an inch—doubtless it will be ultimately though slowly reproduced; the

parts are equal to the task required of them ; the bone, more especially, is quite able to duly overtake its part of the duty, the osseous formation from either end uniting to form a dense and compact reunion of the central portions of the shaft. In all cases the periosteum, when left entire, is capable of executing its share, namely, the formation of the cortical portion ; but that is not enough ; the cortical portion, if left to itself, after extrusion of the sequestrum, unsupported by an interior production from the bone, shrivels and bends, is altogether insufficient as a column of support, and ultimately comes to be in a great measure removed by absorption. Now, reproduction from the mutilated osseous surfaces can only extend a certain length ; in the higher classes of animals, reproduction of tissues is not indefinite, but has its limits ; the two portions of bone will by reparation from either end meet efficiently, by overtaking a distance of a few inches, readily. In seeking to traverse a greater space, however, the reparative effort is likely to flag and fail ; the osseous nodules do not coalesce, but taper finely off, ending in a point coherent with the condensed soft textures around. And therefore practically it must be remembered ; that when a sequestrum has come away, including almost the entire shaft of a long bone, reproduction can scarcely be expected to prove complete, and probably the limb will ever after be more or less inefficient as an organ of support and motion. It is astonishing, however, how successful the restorative effort sometimes proves, even in circumstances of but little hope. In not a few instances, long bones have been almost wholly reproduced. And therefore in necrosis of the entire thickness of the shaft, even of great extent, the chances of cure in the ordinary way ought invariably to be afforded. The short bones, however, if wholly necrosed, are never reproduced.

Also, let it be borne in mind, that for suitable reproduction under any circumstances it is essential that the true inflammatory action shall subside ; otherwise the fibrinous effusion will prove but sparingly plastic, its major part degenerating into a purulent secretion. In practice, our principal care is directed to warding off inflammatory re-accession ; knowing well that should this occur, repair will be interrupted, the cure be at least delayed, and perhaps rendered wholly abortive.

Such is necrosis. As already stated, it may be partial and external. Then the sequestrum has its peculiar characters. For, the dead portion having rapidly parted with vitality at a very early period of the disorder, ere it had time to undergo change, it presents, on its removal, the usual appearances of a portion of the external, dense, laminated texture of bone ; as if it were a part of a macerated skeleton ; but rough and irregular, at its lower and lateral aspects, where by the ulcerative process it has been slowly and unequally separated from the living tissue. Or it may be partial and internal. Then the sequestrum is very distinctive of its original site ; being not only loose as ordinary cancellated texture, but also rough and scarbrous at every point, showing no surface of a smooth and laminated character. Or the entire thickness is included, presenting a portion of the bone, rough and irregular—usually much spiculated—at either extremity ; but in other respects seeming as if artificially removed from the skeleton.

Also, necrosis may be either *chronic* or *acute*. Or rather it may be more accurately stated, that the *ostitis* which leads to the local death, may be either chronic or acute. For the major part of necrosis, that is, the separation of the dead portion of bone, and the formation of its substitute, is invariably chronic, occupying long time in completion, and accompanied by but a very minor grade of the inflammatory process.

The bones most liable to suffer are those most exposed to atmospheric influence, and mechanical violence; and the disease, more especially in its acute form, is found to prevail more frequently in the young than in the old. The causes of necrosis may be briefly stated to be the same as those of its first stage—*ostitis*.

Symptoms.—The symptoms are at first those of acute *ostitis*; on suppuration having occurred, these are aggravated; no relief following the suppurative crisis, as sometimes happens in the soft textures, for here the first investment of the pus is invariably dense and unyielding. But relief comes with evacuation of the matter, whether effected by nature or by art; by the former, the process is tedious, and the abatement of symptoms proportionally slow; by the latter, if early and efficiently adopted, relief is both instant and great. All the surrounding soft parts are very much involved, from the beginning; at first infiltrated by a plastic effusion, consolidating as well as thickening and enlarging; afterwards the seat of suppuration, more or less extensive, sometimes diffuse, more frequently limited by the fibrinous condensation. The matter is discharged usually through several apertures, the number generally bearing a proportion to the extent of the disease; the pouting external orifice, as already stated is termed a *papilla*; the internal, the result either of deficiency of the periosteum, or of perforation of the old bone—according as the necrosis happens to be internal, or not—is termed a *cloaca*. Through the canal, which ultimately assumes quite a fistulous character, the presence of the dead portion of bone is detected, and its condition as to detachment may be from time to time ascertained, by the use of the probe—or what is better, by the introduction of a finger, should the space permit. Should the sequestrum be internal, it is felt rough, yet dense; when external, it is felt smooth and solid, except at the circumference, where by the sulcus of separation it has been rendered rough and irregular. During the stage of separation, and the concomitant one of reparation, discharge is continued; usually copious, and invariably fetid as before stated. In consequence, the constitutional symptoms which during the *ostitis*, both simple and suppurative, had shown all the characters of acute inflammatory fever, often intense, change now into the assumption of *hectic*. But the local inflammatory process has not yet subsided; so long as the foreign body—as the sequestrum truly is—remains unextruded, its presence will continue to be resented by the living parts; true inflammation is sustained in its immediate vicinity, as essential towards the ulcerative suppuration; a minor grade of action continues to pervade the whole part; the substitute bone is busily advancing; in the soft parts, deposit is still in the ascendant, and the absorbents are doing but little towards the remodelling of the limb. Besides, the soft parts become increased in vascularity, sometimes to a very considerable de-

gree; so that when incised—and they cut like a piece of gristle rather than ordinary soft textures—hemorrhage is invariably profuse; not only because the vessels are both more active and more numerous, but also in consequence of the natural hemostatics being opposed by the dense structural change of the parenchyma. Should inflammatory re-accession occur, the symptoms will all be renewed with their pristine severity; and if the newly-formed pus be so situated as not to find a ready exit, it is most probable that serious extension of the original necrosis may ensue. And thus it may happen that necrosis, originally limited to but a small part of laminated texture, may ultimately involve, not only the whole thickness, but almost the whole extent of the bone.

When the sequestrum has become wholly detached from the living bone, it does not always seem loose. For it may, at more than one point, be bound by the tight embrace of the new cortical formation. Generally, however, so soon as detachment is complete, the sequestrum is more or less moveable, as the finger or probe will readily testify; and if not artificially removed—as it should be—in due time it makes its appearance at the surface, and projects there; the protruded portion becoming blackened, apparently through atmospheric influence. And, as a general rule, it may be safely held that a dead portion of bone, which is protruding through an external opening in the soft parts, has been completely loosened from its connexion with the living bone; and that if it seem fixed, it can only be on account of its retention by the cortical portion of its substitute. Sometimes the substitute may itself perish, by inflammatory accession; a result not at all improbable when we consider how recent and comparatively incomplete is its structure, and consequently how low its vital power of resistance or control. And this affords another reason why such inflammatory re-accession should be anxiously provided against, throughout the whole period of repair. Should the super-imposed soft parts happen to become the seat of the hospital sore, the substitute cannot fail to be more or less exposed and involved, and may consequently die and come away, in whole or in part.

When the sequestrum has not only become loose and been dislodged, but also has been fairly removed, the inflammatory process gradually subsides in all its parts. The cortical portion of the substitute contracts, condenses, and sinks to meet the rising new structure which has been elaborated by the parent bone, and which has been a means of effecting the displacement and extrusion of the dead part. The two portions having coalesced, deposit and absorption advance in harmony within the mass, fashioning it into a goodly imitation of the part which has been cast off, and restoring both symmetry and function to that portion of the skeleton. At the same time—action gradually fading as it recedes from the centre of operations—deposit ceases to be excessive in the soft parts, the absorbents become actively engaged in removing, as far as in them lies, the excess which has already occurred, and both the induration and enlargement of the whole limb slowly subside; ultimately, the normal girth is approached, but is seldom if ever actually attained; pain and stiffness gradually diminish, and function too is restored.

The time occupied by the various changes is extremely various. In acute external necrosis of a very limited extent, many days may not elapse between the first onset of the inflammation and the final extrusion of the sequestrum. In more extensive examples, by weeks we will prove more ready reckoners of the time. When the whole thickness of a bone has perished, to some considerable extent, many months may be, and usually are, consumed, ere the bone has been got away; and almost an equal term may be required, ere, subsequently to that event, the limb resumes even an approach to its pristine form and function. In the young and otherwise healthy, the progress will be more rapid than in the aged and infirm; and much will also depend upon the treatment. If inflammatory re-accessions have been either directly induced, or not sufficiently provided against, the term of cure may be protracted almost indefinitely. In spongy bones too, the process is ordinarily more rapid than in dense; the former being more vascular, and better capable of energetic effort. Also the bones of the superior extremity have an advantage, in this respect, over those of the lower.

Treatment.—Again, prevention is to be considered paramount. Treat the preliminary osteitis, with energy yet warily, in order that it may be arrested in its progress, ere any destructive result has yet begun. When suppuration has taken place, and the doomed portion or portions of bone are dead or dying, our object is a minor one; to mitigate symptoms, prevent extension of evil already incurred, and favour the advancement of repair. The first and not the least important indication to be fulfilled, is, early and efficient evacuation of the purulent formation, which bathes the inflamed bone, and has detached it from its periosteum. Some considerable time must be unprofitably consumed, ere the pus can work out its own discharge through the periosteum and other unfavourable investing tissues; meanwhile the patient's sufferings will have been great, and aggravation of the original evil not inconsiderable. Time, texture, and torture may be all saved by an early, free, and direct incision; which, accordingly, should invariably be practised, so soon as the indications of suppuration are sufficiently manifest. Detachment of the sequestrum we commit entirely to Nature, contenting ourselves with overlooking her operation; and taking especial care that she shall not be interrupted. With this latter object in view, the part is kept quiet, used as little as possible, and not put in the way of external violence; and should inflammatory re-accession at any time threaten, leeches, fomentation, especial rest, and the general antiphlogistics if need be, are at once to be employed with a view to its speedy arrest. On this account also, during the chronic stage, when perhaps the purulent secretion is great, and hectic either threatened or fully developed, and when consequently we are anxious to support the system in its difficulties—that support must be prudently conducted, and made to vary from time to time, as circumstances may demand, in order to avoid its being the cause of local over-action.

When the sequestrum has become wholly detached from the living bone, by completion of the ulcerative sulcus in the margin of the latter,

Nature's exclusive operation is over, and it is then our cue to interfere. Nature's power of detachment is adequate and admirable, but her power of extrusion is weak and imperfect; and the surgeon who deliberately imposes on her the latter effort is both negligent and unskilful. She may, and often does, accomplish the task; but only after much suffering to the patient and exhaustion of his frame, and not until much structural change, perhaps irremediable, has occurred in the part—all unnecessary, and which by the judicious assistance of the surgeon, timeously afforded, should have been altogether prevented.

But perhaps a more common error in practical surgery is, interference with the sequestrum before it has become loose. To lay hold of it then, and use violence, after exposure by incision, is certainly to induce a combination of evils. The evulsive effort fails; and consequently the patient has been put to a grave amount of pain unnecessarily and fruitlessly. By the violence, inflammatory re-accession is certainly induced in and around the part originally implicated; in other words, a fresh *ostitis*, probably both acute and extensive, is induced, and aggravation of the necrosis is most likely to follow. Also the loss of blood which attends on such an attempt, whether successful or not, is invariably considerable—coming from a wound of soft parts which are not only unusually vascular, but besides unfavourable to natural hemostatics, as formerly explained—and the patient's state of system is generally such, in the advanced stage of necrosis, as to be altogether intolerant of a repetition of such hemorrhages. Therefore, on this last ground alone, it is plain that the operation for removal of a sequestrum should never be undertaken, unless the surgeon be tolerably certain that his effort will then prove successful. During the whole stage of separation between the dead and living bone, Nature is to be left entirely to herself; the surgeon being only an interested on-looker; prepared to ward off inflammatory re-accession, by suitable antiphlogistics, should that threaten to occur; and careful to limit motion, in order to avert fracture or bending of the changing member. From time to time, he may, by his finger or probe, ascertain the rate and extent of progress, yet using all most gently; but all rudeness of examination must be carefully eschewed, as being prone not only to interrupt the formation of the substitute, but to extend anew the limits of the necrosis.

So soon as the sequestrum has become loose, by Nature's effort—not later, and not before—the surgeon is called upon to take the necessary steps for its removal. An incision is made through the super-imposed soft parts; neither too free, causing unnecessary loss of blood; nor too limited, obstructing the subsequent procedure by want of space. Through the *cloaca* or *cloacæ*, the extent and form of the dead portion or portions are then ascertained; and if the natural opening afford space enough, through this the forceps are introduced, and the sequestrum seized and extracted. It usually happens, however, that the natural openings are not sufficient; the sequestrum proving large, and having become well and on all sides invested by stout cortical formation. It may be necessary, therefore, to convert two *cloacæ* into one, by either the saw or cutting pliers; or one *cloaca*, whether in the old or new

bone, may be enlarged to the required extent, by the cutting pliers, or more suitably in most cases by the trephine. Then, the laying hold of the dead part comes to be of some consequence. Forceps are the best adapted instrument; but in general they are used much too small and feeble. The common dressing-forceps, as found in the ordinary pocket case, are quite unsuitable, except for very small sequestra, wholly unconfined by cortical formation; strong blunt pliers, made for the purpose, should be employed; like bell-hangers' pliers, only longer in both blade and handle, with the former well serrated to prove surely prehensile, and powerful in every part. With them, the dead portion is firmly grasped, and moved to and fro so as to ensure its freedom from the surrounding substitute; and then by a steady pull it is brought to the surface, the leverage power being used if need be to break up any further obstacle which may obstruct its final removal. This saves pain, time, blood, and trouble; for the smaller and shorter instrument is prone to slip; only after repeated efforts is a truly secure hold obtained; and thus often much wriggling and real force are required to overcome unexpected obstacles by unequal means. When the sequestrum is long, and the main aperture towards rather its middle than either extremity, extraction is often much facilitated by cutting through its centre with the bone forceps, and then extracting each portion separately.

Thus, then, the errors most likely to occur in the manual treatment of necrosis are three; too early an interference, ere the natural process of separation has been accomplished; attempted removal of the dead portion, when loose, by inadequate means; and the leaving of it undisturbed, when loose, throwing on Nature the labour of extrusion as well as of separation. That the last is an undoubted error is very plain, when we consider that the sequestrum, when loose, is to all intents and purposes a foreign body, and as such will be regarded by the living parts; creating much local disturbance, and serious inroad on the constitutional power; both unnecessary. By some it has been urged in defence, or at least in palliation, of the indolent system of treatment, that there is a possibility of disappearance of the dead portion; in one of two ways, either by absorption, or by solution in the purulent fluid in which it is soaked. That such hope is altogether futile, from either of these events, has been abundantly proved to demonstration. A portion of bone detached from the living is plainly not amenable to absorption, unless by solution it be presented to the absorbent vessels in a fluid form; and direct experiments, more especially those of Mr. Gulliver,* have clearly shown that dead portions of bone are wholly insoluble in the purulent or other fluids, to which in a living part they may be exposed. A dying portion of bone may be partially absorbed, or disintegrated by ulceration; but dead bone is liable to neither absorption nor disintegration, nor any other vital action. Because a large cavity is found in the interior of a bone, either altogether empty, or containing but a few minute sequestra, we are not thence to infer that the cancellated tissue originally occupying this space has first died and

* Medico-Chirurgical Transactions.

then been absorbed ; it has parted with its vitality, doubtless, not however in a continuous mass, but in molecules, not by necrosis but by ulceration ; and though the dead portions have been removed, they have not been taken back into the system, but pushed forth through the external opening.

At one time it was proposed to apply nitrous or other acid to the sequestrum, with a view to its becoming pliable through loss of its earthy matter, and so capable of being gently pulled away, at the cost of but little pain or blood. The impossibility of confining the acid's action to the part to be destroyed, is a sufficient, because insuperable, objection to the practice.

When the sequestrum has been removed by operation, the wound is stuffed moderately with dry lint, partly to arrest the bleeding, which otherwise might prove profuse ; partly to ensure the wound's ultimate closure, by a gradual filling up from the bottom. The antiphlogistic regimen is rigidly maintained for some days, as a certain amount of inflammatory action is an inevitable result of the interference, however gently and skilfully conducted, and it being evidently of much importance to keep such action within moderate limits ; otherwise the act of removing one dead portion of bone, might become the means of inducing the formation of a second, perhaps more extensive. The limb is kept quiet, free from motion and the support of weight ; for as yet the substitute is hollow, imperfect, consequently weak, and prone on the application of either motion or weight to give way by either fracture or bending. Not till some considerable time has elapsed—varying in different cases according to the different circumstances of each—does consolidation of the substitute occur, sufficient to restore not only the appearance but the function of the bone affected ; and not until then should the patient be permitted to employ the limb with any degree of freedom. And indeed in many cases, in which the temporary weakness of the new formation is peculiarly manifest, it is well not to leave the immunity from function at the discretion of the patient, but to insure this and at the same time afford an adventitious support from without, by incasing the affected portion of the limb in splints and bandaging. And similar care is not unfrequently demanded, during the latter part of the stage of separation ; for then too the bone is very weak, and prone on exertion either to bend or break. Let not, however, the limb be kept constantly rigid and unmoved ; from time to time, let the articulations be supplied by a gentle and passive motion ; otherwise stiffness, or even actual change of structure by disease, may be induced.

Superficial exfoliation may sometimes be hastened ; but this is but an exception to the general rule of non-interference previous to the completion of detachment. When a thin shell of bone, for example, is coming slowly away from the calvarium, it may sometimes be expedited by applying an escharotic, as the red oxide of mercury, or the chloride of zinc ; taking care that the application is limited to the dead portion and its very immediate vicinity. By combining a more continuous and direct death of the living margin, with its molecular disintegration, the loosening of the sequestrum will plainly be facilitated.

Again, after detachment has been completed, a superficial exfoliation may seem fixed. It cannot be by cortical formation, for in the skull this is seldom if ever produced. It may be the result either of redundant granulation or of atmospheric pressure. Granulations may have sprung up from the surrounding parts, both hard and soft, but especially from the latter, to such an extent as to partially overlay the dead portion of bone; confining it to its place, even though wholly freed from attachment beneath. In such a case, the redundant soft parts are to be freely pushed aside by the knife or probe; and the bone, thus liberated, is removed. The atmospheric pressure, when the cause of undue retention, may be overcome by fixing a screw in the dead part, thereby elevating one portion so as to admit the air beneath; then it is loosened in every way, and can be readily lifted from its place.

Amputation is sometimes demanded, though rarely, in necrosis. It is the exception, not the rule. It may happen that in the acute necrosis of the young, violent inflammatory is followed by severe irritative fever, and that both are quickly succeeded by a formidable hectic, which must plainly be relieved at all hazards by removal of its cause; and under such circumstances it may become not only expedient but imperative to take off the limb, only a short time after the first accession of the disease, while the recently dead bone is yet freshly bathed in pus, and when the process of separation has but just begun. Or in the more chronic cases, a like summary procedure may be required at a far more distant date; after not only weeks but months have elapsed; when the separation has become far advanced, but is not yet complete; after the system has for long borne up nobly under the exhausting burden of irritation and discharge; but when, nevertheless, it has evidently become unequal to a prolongation of the contest. Such cases, however, it is great happiness to remember, constitute but a small minority. The greater number are prosperous in their issue, if duly conducted; the system which has borne up long, is enabled to sustain its task till the completion; the dead part is separated and discharged; the substitute condenses and solidifies; the swelling of the soft parts subsides; purulent formation diminishes, and the apertures in both hard and soft parts are closed; the limb is not only saved, but is useful as before. On the one hand we must beware of sacrificing life, in vain endeavour to save a limb; and, on the other, we must be equally careful not to sacrifice a limb, in our anxiety to succour life not yet brought into actual danger; a dilemma in practice, from whose horns we can extricate ourselves only by a happy combination of knowledge, judgment, and experience. And in relation to this subject, it is important to remember, that necrosis is not always as extensive as it seems; discharge may be copious, fistulæ numerous, soft parts extensively involved, and constitutional disturbance great, and still the sequestrum may be of but limited extent both in surface and in depth.

Recourse to amputation may also become advisable, in the case of extensive death of a bone throughout its whole thickness, when the expected reproduction has failed; the limb then bends, shrivels, and is worse than useless; its removal becoming a matter of expediency in the eyes of both patient and practitioner.

In consequence of neglect, a limb may be presented to us much bent, and otherwise deformed, with a large blackened sequestrum partially protruded from the surface. The appearance may be altogether so unpromising, as to lead a hasty and inexperienced observer at once to advise amputation. But this is never warrantable, under even such circumstances, unless the system be already sunk very low, and plainly unable to bear a prolongation of the strain. Then we amputate to save life; but in the majority of examples we ought to save both life and limb. The sequestrum is removed, with an expenditure of as little blood as possible; the limb is laid in splints; the bending is gradually undone by bandaging; by suitable diet and medicine constitutional power is maintained; and thorough restoration of the limb is ultimately obtained.

It will be observed that I have refrained from entering on the discussion of a much vexed question in regard to necrosis; namely, the exact mode whereby the new bone is constituted. I believe that, in internal necrosis, the formation of the new structure, to supply the deficiency of the old, is invariably the work of the parent bone; and that, in both external and general necrosis, the substitute consists of two parts, superficial and deep, the one the product of the old bone, the other begun by the old bone but continued and mainly elaborated by the periosteum. Whether this cortical or external portion is entirely formed by the periosteum; or whether the plasma is originally furnished by the surface of the old bone immediately before its death, and the periosteum is subsequently intrusted with its nourishment, and the management, as it were, of its transitional organization into bone—we are not yet in a position to determine. For my own part, I am strongly inclined to coincide with those who give to the periosteum the power of both furnishing the plasma, and conducting its ossification; for, the early death of the original bone, and the suppurated condition of its periosteal connexion—a profusion of pus usually separating the surface of the bone from the membrane, and that at an early period—seem tolerably conclusive as to the improbability of a plastic deposit being found in the suppurated locality. But, fortunately, the settlement of this matter of theory is comparatively unimportant, while all are agreed on the practical question, namely, that the existence of the periosteum, in a more or less perfect state, is at least essential to the cortical formation. Whether the plasma be the production of the membrane or of the bone, the membrane is necessary for its ossification. And hence the necessity of preserving the integrity of that membrane by every means in our power. It cannot be kept continuously entire, nor is it desirable that it should; matter has extensively and acutely burrowed beneath it, and for the discharge of that matter it must give way at one or more points. Incision cannot be made too early, both to avert the destructive consequences of an acute abscess pent up within unyielding textures, and to substitute the comparatively minute aperture of the bistoury, for the comparatively wide chasm which would result from spontaneous ulceration; perhaps even a mass of the membrane in the state of slough might come away, as sometimes, nay often, happens to facia, under similar circumstances. A certain amount of aperture is essential; we find the

existence of cloacæ—and these, as formerly stated, depend on deficiency of the periosteum—in all respects beneficial; but we desiderate no large chasms in the cortical formation; on the contrary; and therefore it is that we are careful to preserve the periosteum by early and free incision, so soon as suppuration has formed.

VI.—FRAGILITAS OSSIUM.

Bones are most brittle in youth and in old age; but more especially in the latter. The proportion of earthy matter is unduly increased; not actually, but relatively; the oily matter is found in unusual quantity; the osseous texture is lighter and more spongy than in health, and by interstitial absorption the external laminated portion has been very much diminished; in truth the bone may, in this unnatural state, be said to consist of cancellated texture, filled by an oily substance, and surrounded externally by a thin brittle lamella.

Such degeneration is apt to follow long confinement, both in those of advanced years, and in those of middle age who have indulged freely and habitually in spirituous liquors; and more especially when the confinement is the result of rheumatic affection. During the progress of confirmed cancerous disease, too, it is not uncommon. Also, the cachectic states induced by the mercurial and syphilitic poisons, seem manifestly to favour the occurrence of such change in the skeleton; and both scurvy and struma may sometimes be not unjustly suspected of a like sinister tendency. The exciting cause need be but a slight one; a hasty or inadvertent step, turning in bed, rising from the seat or from the knees, a trip on the carpet, or any sudden muscular exertion, may suffice.

Treatment.—When children labour under this affection—as they comparatively but seldom do—the existence of a cachexy identical with the scrofulous is to be suspected; and by the judicious and persevering employment of treatment suitable for the removal of this, the predisposition to fracture from slight causes may after a time be wholly averted. But in those of advanced age, it is otherwise; the predisposition, and the altered state of the skeleton remain; all that can be done in prophylaxis, is to guard against the occurrence of the exciting causes; and at the same time we may endeavour to prevent increase of the cachectic state, by a carefully regulated yet nutritious diet, and exposure to a salubrious atmosphere. When fracture has occurred, the part is to be arranged carefully as in ordinary cases of that accident. It may be that reunion will not occur; it is more than probable that, when it does take place, the process will prove very tedious and the result imperfect; a second or third fracture may occur, during the treatment of the first; the constitution may suffer and sink, and perhaps so rapidly as not even to permit the more than doubtful chance of amputation; yet it is plainly our duty to permit no anticipation of such untoward consequences to influence the care and attention bestowed on our management of the case. Let our treatment be, if possible, more

pains-taking than in ordinary circumstances ; and it is not unlikely that, in a fair proportion of such cases which come under our observation, our care may be rewarded by a prosperous conclusion. During the attempted cure, much judgment is required in both the general and local management. Locally, we wish by bandaging and splints to keep the fragments in close apposition and absolutely immoveable ; constitutionally, we are desirous of supporting the *vis vitæ*, by generous food and other tonics, perhaps freely administered ; but to follow out these indications blindly and with rashness, is almost certainly to induce chronic gangrene of the extremities—analogous to one form of the *gangrena senilis*, over-action occurring in a part and system both of much diminished power. The bandage and splint must be only moderately tight, the diet must be nutritious yet non-stimulant ; the effects of both must be carefully watched ; and should the gangrene appear notwithstanding all our care, the fracture must for a time be comparatively disregarded, and our attention mainly directed to the mastery of the more serious malady, according to the principles formerly detailed. When fracture has occurred in consequence of the cancerous diathesis, often a malignant tumour forms at the site of injury, instead of the normal callus. But that result is by no means invariable, and therefore even in those unpromising cases our treatment should still be the same, or even more careful than in ordinary fracture.

VII.—MOLLITIES OSSIIUM, OR OSTEOMALAKIA.

Both this disease and rickets differ from the foregoing affection, in being characterized by a deficiency, both actual and relative, instead of an excess, of the phosphate of lime. In *mollities ossium*, the skeleton, originally of a normal structure, parts with its earthy matter, becoming soft and pliable in consequence. In this respect there is a manifest difference from rickets, in which the osseous structure is anormal from the first, or at all events from a very early age. In rickets, also, softening and flexion are slow and gradual ; in *mollities ossium*, the progress is rapid, and the distortion may be both instant and great. Further, in rickets, after a time, the anormal condition is departed from, earthy matter comes again in even more than its due proportion, the skeleton becomes solid and unyielding, and the general health may be in a great measure restored ; in *mollities ossium*, the untoward progress is steadfast, there is no amendment in the state of either health or skeleton, and the disease sooner or later proves fatal. Again, the one disease is most common in childhood, while the other is peculiar to maturer years. *Mollities ossium* occurs more frequently in females than in males ; happily, however, it is a rare affection in both. Rickets, on the contrary, seems to have no predilection for either sex, and is extremely common.

In this disease the loss of earthy matter is both rapid and great ; and a copious phosphatic deposit is found in the urine. The general health is much and hopelessly impaired ; flesh, spirits, and strength diminishing daily. The bones are light, soft, and greasy ; and ultimately may

come to consist of a thin external shell, filled with soft matter, partly lardaceous partly oily. Sometimes much pain attends, in other cases the unfortunates suffer little or no inconvenience; in one remarkable instance, related by Mr. Howship, a sense of tightness and much pain were complained of at one particular spot, and there on dissection a marked constriction and depression of the softened bone were found.

The cause of mollities ossium is still involved in obscurity. Loss of blood, mercurialism, and whatever depresses constitutional power, are believed to predispose towards its occurrence. In the case of Madame Supiot—a memorable example—the eating of much salt was a prominent peculiarity, which some were inclined to specify as a cause; but it seems to have been rather an accessory of the general perverted state, than its origin.

The disease is, according to present experience, incurable. And, as in other affections of a like nature, all that can be aimed at in treatment, is a palliation of the more prominent and distressful symptoms.

VIII.—RICKETS.

As formerly remarked, this is an original vice of the skeleton, peculiar to early years; if it be not apparent at the time of birth, it becomes manifest speedily thereafter, during early childhood. It is attended from the first by a marked cachexy of system, which is doubtless identical with the scrofulous. Usually, however, this becomes abated, after a time, and that even independently of remedial treatment; and, contemporaneously with the amendment of general health, the abnormal condition of bone also disappears—a fact which has a most important bearing on the treatment, and which should therefore be borne constantly in remembrance.

The bone is found changed in structure, much in the same way as in *fragilitas ossium*; but, instead of a brittle condition, the result is softness and pliability. The dense laminated texture is almost entirely removed, barely enough being left sometimes to constitute a thin outward shell; cancellated texture consequently largely predominates, of a brown or reddish hue, soft, compressible, and filled with an oily fluid; or a thin sanious liquid may be squeezed out, as if from wet leather. Sometimes the entire bone is expanded, even to a great extent; the calvarium, for example, being in some cases found of more than double its usual thickness, and seeming to consist almost entirely of diploë; sometimes atrophy is the prominent change: in all cases, whether atrophy or expansion exist, the bone will be found much lighter than when in the normal state. The flat bones are perhaps more frequently thickened than otherwise; the long bones usually are atrophied in the shaft, while they show hypertrophy of the articulating extremities. Such enlargement, however, is often more apparent than real, depending mainly on the wasting of the shaft and its soft coverings.

Although the whole skeleton may have thus degenerated, it is obvious that those bones will evince the vitiated condition most which

are most exposed to muscular action, and to the sustaining of superincumbent weight. Consequently, we find the spine and lower limbs most prominently distorted. The former may be bent forward, or to the side; usually the curvature is lateral, with more or less rotation of the bodies of the vertebræ. Antero-posterior bending has occurred to such an extent as to cause a doubling of the aorta, adhesion of the opposed coats at the folded part, and consequent mal-nutrition of the lower limbs. The thighs and legs may have their natural curves merely exaggerated, or they may be bent in a variety of fantastic ways. Their bones, however, are not only bent but flattened; and, fortunately, the greater diameter of the bone is anterior-posterior in relation to the curve; consequently, they are not so weak as they otherwise would be. The pelvis is, as it were, crushed together; the promontory of the sacrum and the acetabula seeming desirous of meeting at a common centre. The ribs follow on the spinal distortion, variously accommodating themselves thereto; usually so as to produce a marked and even sharp prominence of the chest, which is greatly contributed to by a bending forwards of the sternum. The clavicles have their natural curves increased; the scapulæ are not much changed, except in showing enlargement of the articulating surfaces. The bones of the arm and forearm are twisted more or less, but retain much more of their normal character than do the lower extremities; the one set having to bear muscular effort alone, while the other has to contend with both this and superincumbent weight. By the alteration in the important visceral cavities, breathing is oppressed, and the assimilating organs are more or less embarrassed; usually the abdomen is preternaturally prominent. The stature is stunted, dwarfish, and unseemly. Besides, there are the usual characteristics of the scrofulous diathesis. The head is usually large; the features marked, and developed with an unpleasant fulness; the general expression of face displeasing, and altogether so peculiar, as to be almost pathognomonic of the general disease. Although there may be unusual thickness of the skull, yet this is to be understood only in its literal sense; for often the intellectual power is vivid and great.

The predisposing cause of rickets, as formerly stated, seems to be a vitiated state of system, analogous to that of scrofula. The disease may show itself at or soon after birth; but perhaps, more frequently the exciting cause is some of the debilitating accidents incidental to childhood—as dentition, or some of the host of infantile disorders therewith connected. Very often, the change in the skeleton is first observed, on the child's attempting to walk; and then primary deformity is of the lower limbs, chiefly below the knee. The knees approach each other, the ankles diverge, and the shins curve forwards over the ankles; a very different kind of bending from the ordinary bandy appearance, a mere exaggeration of the natural tibial curve, which so often occurs in the heavy, but healthy child, who, perhaps prematurely, has begun to struggle into the erect posture. After the lower limbs, the spinal column begins to yield; and then follow the other component parts of the skeleton; the multiplicity of bones affected, being one of the characteristics of this constitutional disorder, and serving to distinguish it from curvature of single bones—of the spine more especially—

which do not depend on rickets, or any other vice of the general system. In the case of the spinal column, it is most especially important, in practice, to remember that many examples of its bending are independent wholly of rickets; and that those cases alone are rickety, in which the system is plainly and primarily cachectic, and in which the deformity, by bending, is not limited to the spine alone, but affects other bones as well, more especially the ribs, pelvis, and lower extremities. This is a practical point, however, which will be more fully dwelt upon, when treating specially of spinal curvature.

As the rickety patient advances in years the disease does not proportionally become more marked, as is the case in mollities ossium. But at, or after puberty, if not before, the phosphatic deficiency is found to cease, the general health amends, flesh and colour are gained, the spirits rise, motion is more sought and better performed, the skeleton is found to be hardening in its texture; nutrition has begun to be restored, and is gradually approaching the healthy standard. If means, suitable and successful, have been adopted, ere this, to undo the curves and restore straightness and symmetry of form, the firming of the skeleton is an unqualified boon; but if, as is not unlikely, the remedies have been either wholly absent or imperfect in their operation, one result inevitably is an irrevocable confirmation of the existing deformity. This, however, is in some degree ultimately atoned for. The general health is regained, as also power of motion to a certain extent; the muscular fibre becomes fully developed, and the muscles adapt themselves to the shortened and bent bones; the bones though mis-shapen, are strong; and yield no longer, to either muscle or weight; they contain at least the normal proportion of earthy matter, and besides have been strengthened in their curves by new bone deposited, sometimes copiously, in the concavity; the pelvic and thoracic viscera accommodate themselves to the altered circumstances of their including skeleton. And thus, the patient, though a confirmed and unseemly dwarf, weak and puny in his boyhood, may notwithstanding prove a healthy, muscular, and tolerably active man.

Treatment.—The treatment of rickets must be mainly directed towards the amendment of the general system, as is plain from a consideration of the nature and cause of the disease; and, the inductive cachexy seeming to be identical with the scrofulous, a general treatment will be expedient regarding diet, exercise, clothing, tonics, &c., similar to that formerly recommended as tending to subdue the strumous diathesis, and to prevent the establishment of local strumous disease. Friction of the general surface is of use, tending to improve the skin, and at the same time to promote muscular development; muscular exercise too will assist in the fulfilment of the latter indication, but it must be both gently and briefly practised, otherwise the skeleton cannot fail to have its distortion increased thereby. Absolute confinement to the supine posture will do more harm than good, by aggravating the constitutional debility and general disorder; but its occasional use, for an hour or two at a time, or even for that period only which is usually allotted to waking repose, will be found of much service, relieving the weak spine and lower limbs from the weight imposed by the erect and

semi-erect postures. If the spinal column continue to bend, notwithstanding the persevering use of the suitable constitutional remedies, as well as relief by posture, light mechanical support becomes essential. Not by the heavy cumbrous stays, ordinarily employed, at least in times not long by-gone; an apparatus under which it would require the strength of a stalwart man-at-arms to move with comfort; and the miserable effect of which on the delicate and weak patient must ever be in the highest degree disastrous. But by a light and easy adaptation of mechanics, such as the well-informed modern artist now supplies; the object of which is to relieve the spine from the weight of the head, arms, and trunk by taking it upon itself; whilst yet no cramping of muscles is felt from a tight unyielding embrace, nor lassitude, fatigue, and absolute pain induced by an unwieldy and overpowering encumbrance. The principle of construction is simple; light steel rods, supporting weight between the axillæ and the pelvis, leaving the spinal column free. In the use of all mechanical supports, however, let the soft and yielding state of the whole skeleton be remembered, so that we may if possible, not only relieve the parts most oppressed, but also do no harm, by undue compression, to those parts on which the duty of support is temporarily thrown. It would be but a bad result, in attempting to straighten the spine, to crush the pelvis. When the lower limbs are but little bent in the puny child, and the rickety condition is scarcely yet fully developed, no mechanical apparatus should be adapted; the general treatment is to be earnestly employed, moderate exercise is to be encouraged, the patient should be much in the open air, and diet should be free and nourishing; and generally in such cases, the little patient, in common phrase, grows out of the deformity; the limbs spontaneously resuming strength and symmetry. But when the curvature is great, and in other respects the rickety indications undoubted, light apparatus are certainly expedient; as fulfilling three salutary indications; preventing increase of the deformity from bending; diminishing that which has already occurred, by applying reducing power in the required direction and degree; and enabling out of door exercise to be enjoyed, much to the advantage of the general health, and yet without prejudice to the limbs. And in regard to this orthopædic treatment let it always be remembered, that the time for its application is but limited; that if the present opportunity be not improved, the period is probably fast approaching when, by a complete change in the diathesis, the bones become no longer pliable and yielding, but, resisting all remedial efforts, have their deforming curves permanently confirmed. The suitable mechanical apparatus need not be minutely described; the details require to vary in almost every case; the principles of their construction and the superintendence of their use constitute the surgeon's duty, the rest is left to the skilful and intelligent machinist.

In curvature of the spine, not of rickety origin, but depending on either muscular debility, or awkwardness of muscular play induced by careless and improper attitude, benefit is sometimes obtained by maintenance of the strictly erect posture, during a certain number of hours in the day, and by the poising of a light weight on the crown of the

head ; but in rickets, ponderation of any kind will tend to prove an adjuvant not of the cure but of the disease ; the principle of the former, is not the imposing, but the abstracting of weight from the enfeebled column of support.

To the ricketty female, celibacy must be strictly enjoined ; for unfortunately an "aptitude for conception" often exists, along with pelvic change and other circumstances extremely hostile to parturition.

Phosphate of lime has been given internally in a sustained course of large doses, but obviously with a lack of wisdom ; there is no want of earthy matter in the system, but only in the skeleton ; and as yet we have got no means of directly precipitating lime either upon or into the living osseous texture.

A chemical view of the nature and treatment of the disease has lately been broached. "Phosphate of lime is eliminated in large quantities with the urine. This salt, otherwise little soluble, and discharged generally only in small quantity by the kidneys, is, according to Berzelius, readily soluble in lactic acid ; any thing therefore which causes a super-abundance of this acid in the system is capable of depriving the organism of a large share of the earthy matter of the bones. Sugar of milk, grape sugar, starch, and gum, are readily converted into lactic acid, but they are so in the stomach only when digestion is ill-performed, in which case lactic acid may be an abundant product in the system. Rickets and mollities ossium therefore.....may be the results of imperfect digestion and nutrition ; to improve which is consequently our first indication. None of the substances readily converted into lactic acid should be taken, as sugar, starch, gum, &c., nor even milk ; but animal food should be chosen, and such other as is of easy digestion, in aid of which we ought to employ such medicines as may restore the general tone of the system."*

According to this view, scrofulous children may perhaps be saved from the accession of rickets, by early weaning, and careful attention to other diet—less prone to acid, yet equally nutritious.

CHAPTER IX.

DISEASES OF THE JOINTS.

FORMERLY all the graver examples of diseased action in joints were included under one common designation, "white swelling ;" a custom, scarcely convenient, which led to much confusion and inaccuracy as to the nature of the affections, and to at least uncertainty in their

* Marchand. *Lancet*, No. 1034, p. 433.

treatment. But, thanks to the labours of modern surgeons, among whom in this department the name of Sir Benjamin Brodie stands pre-eminent, all such confusion and uncertainty have been dispelled; and each disease, set forth in its proper site and character, may have its appropriate remedy or system of treatment assigned. As can be readily understood, however, such discrimination can only be practised, while the disease is yet comparatively recent; for, after a time, the morbid action, in whatever texture it may have originally dwelt, involves the whole articulating apparatus in one chaotic mass of disease. It is during the comparative infancy of the disease, that any treatment is most likely to prove successful; and it is so far fortunate, that it is at the same period we enjoy a facility of discrimination and accurate diagnosis.

We shall consider, in succession, the results of the inflammatory process in the different component textures of the joints; 1. In the Synovial Membrane; 2. In the Cartilage; 3. In the Bones.

Synovitis.

By this term is meant the inflammatory process occurring in the synovial membrane, a tissue in many respects resembling the serous, both in health and disease. The action may be either acute or chronic.

I. ACUTE.—The inflammatory process tends to spread from one part over the whole membrane, to assume an intense character, to be accompanied with much exudation, and to result in serious change of structure. At first the membrane becomes congested, turgid, and shows an apparent increase of vascularity; the natural secretion is poured out in increased quantity, and of a more aqueous character than in health. This necessarily causes general swelling of the part, which forms almost synchronously with the first painful indication of the accession of the morbid action—an occurrence, diagnostic of the affection. Then, the membrane begins to change in structure, by interstitial exudation; it becomes thickened, soft, red, almost pulpy, and loses its translucency, as well as the smooth glistening appearance of its internal surface. At this time, the effusion ceases to be chiefly serous, and contains more or less of fibrin, usually floating about in detached flakes; and also the fibrin is found beginning to adhere to the surface of the membrane, as well as to be deposited in its parenchyma. It is at this stage of the process that adhesion may occur between two opposing portions of the membrane, or extensively so as to obliterate a large part of the joint's cavity. But this result is of comparatively rare occurrence, probably for two reasons: first, the action usually tends rapidly onwards, and soon overpasses the opportunity for plastic formations, quickly arriving at the suppurative and ulcerative stage; second, because the presence of much fluid in the joint is plainly inimical to adhesion, the surfaces being separated by the distention. Subsequently, as the suppurative crisis is approached, and also after it has occurred, the change of structure increases; the membrane is not only thickened and changed in itself, but becomes incorporated with the plastic exudation which has adhered to its free surface, and which by partial

organization has assumed a membranous appearance and function. This layer of false membrane, as it is termed, is in all respects analogous to the pyogenic membrane of the ordinary acute abscess; by the exercise of its newly assumed function, purulent secretion is continued in greater or less quantity; at first it mingles with the serum already within the synovial pouch, and the contents are sero-purulent; but soon the serous character is altogether merged in the purulent, the thinner portion of the fluid having probably been absorbed. Throughout the whole period, the super-imposed soft parts have been sympathizing closely; themselves involved in a minor grade of action, and consequently becoming swollen and infiltrated thereby.

The symptoms which accompany these results of the inflammatory process are sufficiently distinct. Pain is early and severe; it is constant, and, gradually increasing in severity, ultimately becomes intense. There is swelling, also gradually on the increase, sometimes becoming great; and, as already stated, its accession is synchronous with that of the pain. The swelling is not altogether uniform, but is much more so than in the chronic form of the affection. The joint naturally becomes most prominent at those points where there is least resistance; in the knee-joint, for example, we find the bulging to be chiefly laterally and beneath the tendon of the quadriceps muscle. But then such peculiarities of tumour become very much obscured and masked by the general œdematous swelling of the superficial parts. The skin is red, tense, hot, and sensitive. The pain is general, pervading the whole part, but greatest in the interior; much aggravated by pressure, and altogether intolerant of the slightest motion. A position is assumed, naturally, in which the parts affected are most relaxed, and pressure removed from the opposed surfaces; relief is felt from this posture, and it is not only involuntarily assumed but maintained. Also the muscles in the neighbourhood are found somewhat involved; their tonicity is increased, as evinced by firm solidity of the muscular fibre, and rigidity of the tendon. For example, in the inflamed knee, we find the joint in a state of semi-flexion, with the ham-strings tense and hard as cords. The muscles are liable to spasm also, whereby involuntary startings of the limb occur, especially during the short and uncertain periods of disturbed sleep; and by the jerking motion thereby occasioned, all the symptoms are much aggravated. The constitutional labours under inflammatory fever of a grave kind, which increases with the progress of the local disorder. On suppuration having occurred, there is marked aggravation of all the symptoms, both constitutional and local, and a succession of rigors usually ushers in the exacerbation. The fever rises higher, and the system is proportionally more oppressed; the swelling is larger and more tense; the pain, heat, and feeling of tightness are increased, accompanied with a deep-seated throbbing, and each pulse seems still farther to augment the pain. The superficial swelling becomes of a more urgent character, being the result now of a higher grade of action. The fluctuation within the joint also changes its type, and affords to the experienced touch a tolerably certain indication of pus, not of serum. At one or more parts, the swelling begins to point; the matter now approaching the surface, by ulceration and

absorption of the intervening textures. Ultimately the integument at the prominent points either gives way or is opened artificially, the matter is discharged, and the joint's cavity is free to the external air. For a short time, immediately subsequent to the evacuation, the more urgent symptoms subside, by the relief of tension; but very soon a second aggravation generally ensues, even greater than that which followed on the first formation of matter; a fresh inflammation, as it were, seizes on the parietes of the abscess, and the destructive process rages anew, accompanied by violent constitutional disturbance, perhaps now of the irritative rather than of the inflammatory type of fever. This, in its turn, is not unlikely to give way to hectic; the whole joint having now become a prey to the destructive results of inflammation, and the system beginning to sink beneath its burden.

Such is the nature of acute synovitis, when its whole course is run. But it is to be understood that at any period of the process, the action may cease its advance and begin to subside, spontaneously or from treatment; and that the symptoms will vary accordingly.

The disease may originate without any apparent cause; more frequently it is the result of injury—as bruise or wound. In the latter case, unless the union be by simple adhesion, synovitis is inevitable; for, it being necessary to granulation that the track of the wound should previously inflame, a portion of the synovial capsule inevitably partakes in that process; and, as already stated, it is a peculiarity of that tissue that inflammation attacking a part quickly spreads over the whole. Whence a plain and practical inference is to be drawn; how in the treatment of wounds of joints it is of the greatest moment to subdue or avert inflammation, and ensure simple adhesion. Rheumatism is a frequent predisposing cause of synovitis, the action being modified by the specific diathesis; and during the prevalence of this diathesis a very slight exciting cause suffices; or even this latter may be altogether dispensed with. Exposure to cold often induces the disease, even in persons previously of the most robust health; but most readily, of course, in those filled with rheumatic tendencies. And mercury, among its many evil results, often remote, is an undoubted and frequent parent of some of the worst forms of synovitis; at least, if not both predisposing and exciting cause, it is certainly the former.

The joints most liable to be attacked are those of the extremities; most exposed to external violence, and to atmospheric vicissitude; the knee, elbow, wrist, and ankle; on the whole, the first is the most frequent sufferer.

Treatment.—The treatment is early, active, and severely antiphlogistic. Blood is taken away copiously from the near vicinity of the inflaming part, by leeches or by cupping; and unless contra-indicated by other circumstances than those connected with the disease, blood is also taken from the system, by venesection; it being obviously of the utmost importance to check the action at its outset, or at all events to bring it down to a slower rate of progress, and to a minor grade of intensity. The tissue affected is endowed with both importance of function and delicacy of structure; after bleeding, therefore, the exhibition of calomel and opium is advisable; as being most calculated, by its

systemic influence, to save structure and consequently retain function. Should circumstances render mercurialization inexpedient, or at least hazardous, full doses of the solution of tartrate of antimony may be substituted. When the rheumatic diathesis is apparent, the colchicum will be preferable to either; pushed, in full doses, till its physiological effect has been at least threatened if not established. The limb is encouraged to maintain the relaxed posture voluntarily assumed; and immunity from motion is anxiously attempted to be secured, by gentle deligation of the part to soft pillows skilfully and carefully arranged. Purgatives are inexpedient; as opposed to immunity from motion. Should the tendency to spasm prove troublesome, opiates are advisable, given in combination with camphor and hyoscyamus. Fomentation is applied to the part, regimen is most strictly antiphlogistic; and in short all the ordinary details of both that regimen and treatment are rigidly enforced.

In the great majority of cases, early seen and judiciously treated, the action is arrested in its progress, ere the suppurative crisis has been attained. Then, as ordinarily happens in acute serous effusion, the work of resolution slowly advances, almost spontaneously; aid from treatment consisting merely of continued rest of the part, occasional fomentation, and maintenance of the spare regimen. The absorbents of themselves are soon busy in clearing away the results; and in most cases are equal to the efficient completion of their task. But should they begin to flag, then they may be assisted from without, by gentle friction, pressure, stimulating plasters or inunction, or the slightest forms of counter-irritation; these however being always adopted cautiously, and as if with hesitation, lest by their premature use the embers of the not yet extinct action might again be lighted into a flame.

When action has not only subsided, but its results also have been removed, motion is to be gradually restored; at first passive and gentle, always desisted from when pain is induced; and invariably both commenced and conducted with the same precaution as in stimulation of the absorbents. Many a limb has been lost, for many a joint has suppurated, in consequence of re-accession of acute action by imprudent resumption of motion. It is doubtless an object of very great importance that the part's function should ultimately be restored, that the limb should not be permanently bent, and the joint not permanently stiff; but an over-anxiety to fulfil this indication will lead us to straighten the limb, and move the articulation, too much and too soon; and surely the safer side on which to err, is to run some hazard of trouble by threatened ankylosis,—none whatever of reinduced disease, and probable disorganization of the part thereby.

During the whole period of cure, up to the time when motion is begun to be restored, all movement in the joint is to be most studiously avoided. During the acute stage, the part is intolerant of bandages and splints; then we have to trust to pillows, and gentle deligation thereto beyond the inflamed part. But so soon as the acute stage has passed away, sufficiently to permit the application of splints, these are forthwith had recourse to, as being by far the most efficient means of fulfilling the all-important indication in view. The preferable kind are

those of thick leather, softened by immersion in hot water; applied when pliable—usually one on either aspect of the limb; retained by bandaging for a few hours, till they harden into a case closely adapted to the undulating surface of the part; then removed, and lined by some soft substance, such as tow, wadding, or chamois leather; reapplied with but moderate tightness, and constantly retained.

When unfortunately our efforts to arrest action have failed, and suppuration has occurred—the interior of the joint being in truth converted into an acute abscess—the general rules of surgery are not to be departed from; an early and free incision should be practised. This, however, it is plain, can only be had recourse to when the symptoms are so very distinct as to leave not the slightest doubt of suppuration having occurred. To plunge a bistoury into the cavity of a joint filled with serous or sero-purulent fluid, would be a most unwarrantable procedure; rendering disorganization certain, where otherwise all might have been saved; such fluids, and the change of structure which attends on them, being perfectly amenable to absorption. When there is any doubt, therefore, as to the nature of the contents, we withhold the knife; if they are purulent, the natural process of pointing will soon disclose the real state of the matter; and then incision is unhesitatingly performed. Should the nature of the contents continue doubtful, the case having assumed a chronic form, puncture may be made by a fine grooved needle, subsequently applying exhaustion by means of a cupping-glass if need be, in order to exhibit a portion of the fluid from within.

After incision, accession of additional inflammatory action is inevitable, and has to be guarded against accordingly; the maintenance of rest, with the other local management, is if possible more assiduous than before; and temporary resumption of the general antiphlogistics will probably be expedient: Afterwards, our expectation is that the cavity will gradually contract and close, as do other acute abscesses; but, on account of the peculiar nature of the parts implicated, it is not improbable that such hopes may be disappointed.

Purulent formations not unfrequently form in the larger joints, in the latter stage of severe phlebitis. Such cases, however, are altogether different from the ordinary acute abscess. They are not the disease, but only a symptom of one infinitely more formidable; under which latter the system has rapidly given way, and is altogether irrecoverable. The complication by articular abscess, does not cause, but probably accelerates dissolution—already very near. There is seldom time or opportunity afforded for treatment of the local malady—even should that be deemed expedient; but if there should, general principles are still to be enforced; a free and dependent incision is practised.

II. CHRONIC SYNOVITIS.—This may be either simple in its nature; or connected with and marked by the scrofulous cachexy.

1. *Simple Chronic Synovitis*.—It may be original or secondary; the inflammatory process may have been chronic from the first; or originally acute, subsequently assuming the chronic form. The pain, heat, &c., are comparatively slight. Swelling is the prominent symptom.

And now the peculiarities of bulging, dependent on the structure of the joint, come to be distinctly seen—a circumstance diagnostic between the chronic and acute forms of synovitis—for the super-imposed soft parts sympathize but little in the perverted vascular action, and consequently cause little or no obscuration of the synovial tumour. The membrane is thickened, dull in hue, increased in vascularity, and gradually changes its smooth internal aspect into a soft, pulpy, or villous surface; the cavity contains more or less of a serous fluid, either pure, or mingled with a small proportion of a puriform secretion; this has accumulated slowly, the parts have gradually accommodated themselves to its presence, and the process of distention is consequently attended with but little uneasiness.

Sometimes the process of accumulation is peculiarly indolent and painless, and yet tolerably rapid in its rise; the superficial soft parts are wholly uninvolved, the whole disease seeming to be the product of a suddenly occurring passive congestion of the synovial membrane, and limited to that texture; the fluid is entirely serous, and the form of the swelling is very decidedly influenced by the natural configuration of the joint. This condition is termed *Hydrops Articuli*. The knee is its most frequent seat; and it is most apt to occur at or beyond the adult age, and in those who have suffered from mercurial exhibition.

Chronic synovitis, though not in itself important, or urgent in its nature, is nevertheless fraught with danger by continuance. For, at any time, but a slight exciting cause will suffice for the induction of acute inflammatory accession; and, even supposing that this do not occur, structure is certain ultimately to be most seriously changed by the persistence of the present action, chronic though it be; and that not only in the texture originally involved, but in others to which the action may gradually extend—the cartilages, and even the bones. In another point of view also, the affection is important; when we remember how much more difficult of satisfactory removal are the results of chronic than those of acute effusion.

The prominent symptom, as already said, is the unequal, fluctuating swelling; there are also dull pain or uneasiness, some heat, and great limitation of motion; the joint is more or less flexed, and the tendons of the flexor muscles implicated gradually assume a rigid condition. The limb by confinement wastes, and its muscles become small, weak, and flabby.

When the diseased action is extending to other tissues, and formidable though chronic change of structure is in progress, the swelling often loses its lax fluctuating character; the thinner portion of the synovial contents is probably being absorbed; fibrinous deposit is taking place both within and without its cavity, and in the substance of the textures themselves. The swelling consequently becomes more solid and less fluctuating; the joint is more painful, and more abridged in motion; and constitutional sympathy, before perhaps slight, now becomes considerable—tending towards the hectic type.

The disease is seldom the result of external violence. More commonly it follows on exposure to cold; or it may be attributed by the

patient to some slight twist or strain ; and it most frequently occurs in those who have suffered by the venereal poison, by the mercurial, or by both. Rheumatism too is a fertile inducing cause.

Treatment.—Moderate local depletion, by leeching, is at first employed, with rest ; not so much on account of a remedial effect expected from itself, as for rendering the subsequent application of counter-irritation, on which the main hope of cure has to rest, safe and expedient. Were this to be had recourse to at once, stimulation and increase of the chronic vascular action might result, instead of its arrest and subsidence. The preliminary gentle antiphlogistics stop the progress of the action ; the counter-irritation gradually subdues it, and effects its final extinction ; at the same time favouring disappearance of the anormal deposits, both solid and fluid. The counter-irritants may be varied according to circumstances ; blisters, in succession ; croton-oil embrocation ; tartar emetic ointment or solution ; or an ointment of nitrate of silver, strong enough to produce a pustular effect by inunction—are the most common and suitable forms. When action has fairly ceased, and all is quiet, then the attention may be mainly directed to discussion, or stimulation of the absorbents. With this view various discutient plasters may be applied ; as the gum plaster, or the mercurial, or equal parts of both. Or pressure may be applied, either by simple bandaging, or by combination of this with plaster. The iodide of potassium may be used in the form of ointment, as well as given internally ; or a strong solution of iodine, either aqueous or alcoholic, may be pencilled on the surface. But still let the effects of these remedies be carefully watched, lest unfortunately over-stimulation be induced. And throughout the whole treatment let the paramount indication be, rigid maintenance of absolute rest in the affected part, by splints ; at first lightly applied, so as merely to prevent motion ; afterwards with tightness, in order by their pressure to assist in the favouring of absorption. In due time, by passive motion, cautiously increased, the joint's function is restored.

Constitutional management is not to be disregarded. Invariably more or less disorder will be found in the system ; and rectification of that is essential to due advancement of the cure. If any peculiar cachexy exist, as is not unlikely, it must be met by the suitable remedies ; obstinate and lurking venereal taint, by an alterative and cautious mercurial course ; mercurial taint—the more frequent of the two, either single or combined with the preceding—by sarsaparilla, or the iodide of potassium ; rheumatic diathesis, by colchicum, &c.

In hydrops articuli, the most trustworthy remedy is iodide, used both externally and internally. Should it fail, mercury, unless otherwise contra-indicated, may be cautiously tried in a similar way : externally, in the form of ointment or plaster ; internally, as an alterative course, mildly and prudently, and as if reluctantly conducted. Or the tartrate of antimony may be given internally, pushed in almost as full and as frequent doses as for pneumonia ; this, however, is a harsh remedy, and not to be employed till others more simple and more usual have been tried and failed. Locally, acupuncture, with subsequent application of the exhausted cupping-glass, has been tried ; but the result has proved unsatisfactory, as to cure ; and, besides, the practice is not free

from the risk of lighting up acute inflammatory action. And a similar objection will apply to simple acupuncture, practised with the view of permitting the serum gradually to escape into the superficial cellular tissue; so converting the dropsy into diffuse oedema. Lately, it has been proposed to treat the part as if it were a hydrocele; to draw off the serum by tapping, and subsequently to inject a solution of iodide. The practice seems much more likely to effect disorganization of a joint than its cure. And, until ample experience shall have declared it a safe procedure, we shall hold such tamperings with the larger articulations—the knee, be it remembered, is the most frequent seat of the disease—to be in the highest degree rash and unwarrantable.

2. *Scrofulous Chronic Synovitis*.—This affection is accompanied with marked indications of the strumous cachexy, throughout its whole course, as well as previous to its accession. The membrane slowly and silently degenerates into a gelatinous pulpy substance, soft, and of a whitish or light gray colour; at first with merely an exaggeration of the ordinary secretion, slightly perverted in character—thicker and more opaque. But suppuration is not unlikely to follow, probably occasioned by acute inflammatory accession; or, it may be, merely in accordance with the onward progress of the original disease. From whatever cause induced, the occurrence is quickly followed, as usual, by great aggravation of the symptoms, both general and local, and speedy disorganizing involvement of both cartilage and bone.

This is an affection altogether different from the brown and dense degeneration of the synovial apparatus; the one is simple, and comparatively tractable; the other is suspected of malignant tendency, and is but little obedient to any remedial treatment.

The symptoms differ from those of ordinary synovitis. The patients are usually adolescents, and evince more or less strongly the scrofulous cachexy. A slight injury, as a blow, strain, or twist, may or may not have been sustained by the part. The joint slowly swells, and has its motion more and more impaired; but little or no pain is experienced. The swelling is soft, doughy, somewhat elastic, but totally devoid of any thing like true fluctuation; the integuments are pale, and scarcely tense; and even free pressure and manipulation are comparatively well borne. In this indolent condition, the joint may continue for months; but, failing gradual cure, or approach thereto, suppuration usually supervenes; an event, followed and characterized by the usual aggravation of symptoms, both local and general.

During the progress of this disease—and indeed the observation may be extended to almost all serious and chronic structural change of joints—the whole limb undergoes an atrophy; hard textures as well as soft. The bones become more slender in their shafts, and of less density; the adipose tissues disappears by absorption; the muscles waste, grow flabby, pale, and weak; in the lower part of the limb passive congestion and oedema are not unfrequent.

It may be here stated, also, that in many examples of diseased joints, in whatever texture morbid action may have originated, the advanced stage is often complicated by enlargement of the lymphatic glands; sometimes indolent, sometimes active and prone to suppuration; in the

axilla, from diseased elbow, for example ; in the groin, from diseased hip or knee. The complication is a serious one, and ought always to be taken into account in both treatment and prognosis.

Treatment.—In the early stage, the local treatment is the same as for the simple chronic synovitis: rest and counter-irritation, the latter preceded by very moderate depletion. Constitutionally, the ordinary remedies are to be employed, whereby the system's taint may be most hopefully opposed ; and this anti-strumous treatment must be maintained unweariedly throughout. When the indolent condition has become thoroughly declared, pressure and confinement from motion—so as both to arouse absorption of the redundancies, and to permit of its advance without interruption—constitute the principal remedial means.

Rest and pressure, indeed, are powerful agents of cure in all chronic affections of joints, however originated ; whether occurring in their hard or soft tissues ; but most hopeful in the latter case, as can readily be imagined. And there is every reason to believe, that to the better conducted, as well as more frequent use of them, the marked improvement in the treatment of diseased joints, in modern times, is mainly to be attributed ; many an articulation is now saved, which formerly would have been unhesitatingly doomed to amputation. Much credit is due to Mr. Scott, for having directed attention to the importance of rest and pressure, combined with moderate irritation of the surface ; and a modification of what is ordinarily termed "Scott's dressing," will be found a most valuable remedy, in all chronic affections of joints, in the truly indolent stage ; more especially in those wherein the diseased action has not only originated in the synovial apparatus, but is still limited to that tissue. The limb having been uniformly supported by a bandage, from its extremity up to the affected joint, the surface of the swelling is covered by strips of lint, spread with some gently stimulating ointment—soap cerate with camphor, for example, or that with a greater or less proportion of the unguentum hydrargyri ; the whole articulation is then surrounded by long bands of adhesive plaster, drawn with moderate and uniform tightness, so as to support and firmly yet uniformly compress the parts, without producing absolute pain or uneasiness. Above all, splints are applied to secure total immunity of motion ; and they may be of leather, of pasteboard, or of wood—the first usually the most suitable. When this dressing has become loose, from subsidence of the swelling—as usually happens in a few days, when first employed, progress thereafter becoming more gradual—it is reapplied, as often as may be necessary. But should fresh excitement occur in the joint, from any accidental cause, this system of dressing must be discontinued, until such excitement has been subdued by the usual means ; and when the pressure is resumed, it should at first be very moderate. Such acute re-accessions are least likely to occur in the truly synovial affections. During the treatment, the limb must be kept, or gradually brought into the most advantageous position for future usefulness ; particularly, if, from the nature, duration, and extent of the disease, there is reason to suspect ultimate impairment of the joint's motion. Thus, by steady extension with splints, the knee-joint may be brought into nearly a straight position, so that it shall be serviceable in progression ; and the

elbow may be bent, to form a right angle with the humerus, so as to be convenient for prehension. By prudent yet persevering friction, and occasional passive motion, these desirable changes may be greatly facilitated. But all such alterations of stiffened limbs must be proceeded with very cautiously, otherwise they may occasion undue excitement, and consequent renewal of the disease.

The Brown Intractable Degeneration of the Synovial Membrane.

The joint most frequently attacked by this formidable disease is the knee; and the usual patient, is the adult female. The synovial membrane slowly and insidiously degenerates into a pulpy-looking substance, altogether different from the preceding affection; the mass is of darker hue, and of greater thickness and extent; it is also of greater density, and intersected by many firm, fibrous bands, somewhat after the manner of carcinoma. I am far from stating that the two diseases are identical; but they certainly do resemble each other, as to the fibrous constituents, in the apparent section; and though the disease, now in question, cannot be roundly termed truly malignant, yet most certainly is it but little amenable to any remedial treatment, and very prone to assume, if it do not originally possess, malignancy.

At first the external indications of the disease are similar to those of the simple gelatinous degeneration; a gradual, soft, comparatively painless tumour of the joint, unaccompanied by superficial excitement. Yet the swelling is more diffuse, and less prominent, as if indicating that the diseased action had more securely and deeply fastened on the whole extent of the joint; it is more decidedly elastic, often simulating true fluctuation very closely; it is of a uniform character, and has no peculiar bulgings dependent on the natural form of the joint; the uneasy sensations are greater, and obviously more on the increase—of a deep gnawing kind, gradually augmenting into smart lancinating pain; there is an obvious concomitant cachexy, but quite different from the scrofulous—rather like that which attends on malignant diseases—a sallowness of hue, loss of strength, flesh, and spirits, and ultimately gradual sinking in the form of a modified hectic.

It seldom if ever assumes the quiet indolent form so frequent in the simple synovial degeneration. Only at its commencement is it slow and latent. Once fairly established, it advances steadily, and sometimes with rapidity. Ultimately the joint is wholly destroyed, in one or two ways; either by the ordinary inflammatory products, or by the formation of a malignant tumour. In the former case, a suppurative crisis takes place, as in the simple degeneration; cartilages, bones, ligamentous apparatus, are all quickly involved in ulcerative destruction; the joint opens, probably at several points; urgent hectic is lighted up, and amputation is imperiously demanded; or the patient may sink without any opportunity having occurred for the trial of that doubtful remedy. In the latter case, there is no acute crisis, followed by opening of the joint and its palpable disorganization; but there is a steady increase of both the general and local symptoms. The face gets more and more thin and cadaverous, the frame wasted, and the vital

power sunk. The tumour continues steadily to advance, and ultimately it is observed that the rate of growth has plainly increased; the surface becomes tense, smooth, polished, and traversed by large veins; pain is more acute, constant, and lancinating; elasticity is more prominently its characteristic than ever; fluctuation may be suspected, and a plunge made by trochar or knife, but nothing escapes save blood, and that copiously; in fact, the swelling has now truly become an encephaloid formation. The disease began, intractable; early, it showed a malignant tendency; ultimately it has openly assumed not only an avowedly malignant action, but also the peculiar deposit of perhaps the most malignant of all adventitious formations. This latter, however, is to be considered only as an occasional result; the former—disorganization by the ordinary inflammatory products—is certainly the more frequent.

Treatment.—This may be comprised in very few words. In the early stage alone can we hope for an altogether successful issue, and this is to be sought for by the ordinary means; rest, counter-irritation, and attention to the general system. Even then, cure is far from certain; nay, it will prove the exception rather than the general rule. After the onward progress has been fairly declared, the sooner amputation is performed the better; a severe measure, doubtless, but fully warranted by an experience of the general nature of the disease; and a measure towards which we should be all the more urgent, by reflecting that if the medullary formation be once established—and it is at least possible that such may be the impending issue—even amputation may prove at the best but a palliation; the general disorder continuing unabated, and hasting forward to a fatal and early termination.

The Fimbriated Synovial Membrane.

Of this comparatively rare affection, there are but few examples even in our best appointed museums. “The synovial membrane may be studded on its inner aspect with pendulous substances projecting into the cavity of the joint; sometimes of almost cartilaginous consistence, but more frequently of a fatty appearance. The entire surface of the membrane is occasionally covered with these bodies, which are of a white or yellowish colour, and very variable in size and shape; the smallest presenting the form of villi not much larger than those of the jejunum, the largest having somewhat the magnitude and appearance of the appendices epiploicæ of the large intestine, while many of an intermediate size approach in appearance to a lemon seed. In some instances the membrane is only partially pervaded by them, and sometimes they are arranged like a fringe around the edge of the articulation. They are generally very smooth on the surface, which appears to be perfectly continuous, if not identical, with the synovial membrane. Their attachment is sometimes broad, sometimes very narrow and pedunculated, often merely filamentous; so that a little farther thinning of the part, or slight force acting on the body, would remove it from the capsule, and throw it loose into the cavity of the articulation. The disease has been most frequently seen in the knee, and sometimes in the elbow.

"The affection is obscure in its nature, and slow in its progress; the joint is the seat of pain after and during exercise, probably from the anormal processes interfering with the motions of the articular surfaces. As the disease advances, the joint becomes swelled and elastic, unattended generally by ulceration of the tissues within or around it. In examining the part, when the articular surfaces are moved on each other, it will be found that their motion is more or less interfered with; and considerable irregularity in their action may be felt by the hand placed firmly on the joint during the procedure."*

The same treatment is required, as for the ordinary synovial derangement, of the most chronic form.

The Inflammatory Process in the Exterior of Joints.

This may be of the simple and ordinary kind; and then prone to suppuration. Or it may be of an obviously rheumatic character; tending rather to chronic change of structure.

1. *Rheumatic*.—When acute, it is usually merged in a deeper and more important affection; it may originate exteriorly to the joint, but this sooner or later is involved, usually at a very early period; and the case may then be considered as one truly of rheumatic synovitis. But the chronic form very frequently is not only originally, but permanently, wholly exterior to the articulation; or if the latter do sympathize, it is only in a very minor grade of action, barely sufficient to increase slightly the natural exhalation of the part—not greater sympathy than the exterior often shows in the less serious inflammatory affections of the joint.

The inflammatory process is of a low grade, and chronic in its nature; situated either in the periosteal investment of the articulating extremities of the bones, in the fibrous tissues exterior to the joint, or in both. The periosteum thickens, and becomes vascular; the corresponding surface of the bone, sympathizing fully in the action, opens out in texture, and becomes studded by osseous nodules, sometimes shooting outwards in a spiculated form; and this new osseous formation may, by encroaching on the joint, come seriously to impair its power of motion, or even ultimately to cause complete stiffness by an external true ankylosis. The ligamentous and other fibrous tissues undergo a somewhat similar change; they increase in bulk and in vascularity; more or less plastic matter is interstitially exuded, and, becoming organized, seriously impedes motion, and may result in more or less complete rigidity. All this is attended by the ordinary rheumatic symptoms; more especially, by pain, often severe, aggravated nocturnally and by atmospheric exposure or vicissitude; swelling, deep-seated, and hard, painful on pressure, and not unfrequently somewhat masked by superficial oedema; a stiffness and crankiness of motion in the joint, gradually increasing; and rheumatic signs not wanting in perhaps many other parts of the frame.

There are plainly two dangers to be dreaded from continuance of

* Liston's Elements of Surgery.

such an affection; inflammatory accession, involving the joint in acute synovitis: and persistence of the original malady, slowly yet surely compromising the function of the part. On both counts, therefore, it is our duty to cope zealously with the malady, at an early period. Locally, by the ordinary antiphlogistics; especially leeching, or cupping in the vicinity, fomentation, rest, and, if need be, counter-irritation. Constitutionally, by the exhibition of colchicum, iodide of potassium, or other remedies held as suitable opponents of the rheumatic diathesis.

2. *Simple*.—The inflammatory process occurring in the parts immediately exterior to a joint, unconnected with any peculiar condition of system, is usually acute, and tends towards the suppurative crisis. It may be the consequence of external injury; or it may be but a part of a more extensive disorder—as erysipelas. Or the affection may be idiopathic, and chronic in its nature; consisting first of a fibrinous exudation, causing hard swelling with stiffness of the joint, dull and indolent; and after months passed in this type, then assuming the suppurative action. However occasioned, the suppuration follows the usual course, and the matter seeks the surface. If opposed in that direction—as it is certain to be, if originating among and not exterior to the fibrinous tissues—it cannot but extend both laterally and in depth; so, obviously and imminently, endangering the articulation. If purulent irruption take place there, it will be hard to prevent the immediate invasion of such an inflammatory action as shall result in destruction of all the component textures, as well in the establishment of the most violent and alarming constitutional disturbance.

The treatment, therefore, must be both early, and actively antiphlogistic; in order to arrest the inflammatory process, if possible, ere the suppurative crisis shall have been attained. When this has occurred, an incision can scarcely be made too early, free and dependent, in order to avert the articular irruption. In either case, the most rigid rest of the part is to be maintained, and the constitutional symptoms are subdued by the suitable remedies.

Tophi.

These are concretions connected with the extreme articulations, more particularly of the fingers; sometimes within the joint, more frequently exterior to it—at least in the first instance; and are composed of the urate of soda. They are undoubtedly connected with, and probably owe their origin to the gouty and rheumatic diathesis, especially the latter. They may remain in an inactive state, either stationary or gradually enlarging, for a long period; or imperfect suppuration may occur on the surface, opening the skin, and disclosing the concrete matter slowly disintegrating, and crumbling tardily away with the thin puriform discharge; and this may be accompanied with some pain, and redness and swelling of the surrounding integument. Or a chronic and imperfect suppuration and softening may pervade the whole mass, instead of being limited to the surface; this, however, is a comparatively harmless event, seeing that the proper texture of the joint has been previously annihilated by gradual structural change, antecedent

to the peculiar deposit, or at least co-existent with it; what was the joint may be opened into, but the circumstance will not be marked by any of those serious consequences which would be certain to accrue did any form of the synovial apparatus remain.

Such concretions, when fairly formed, are plainly but little amenable to local treatment. The great object is to prevent their formation; by constitutional management directed against their cause, the gouty or rheumatic diathesis. And, according to late chemical disclosures, an important auxiliary has appeared to the ordinary remedies in vogue; namely, the benzoic acid; which, given in full doses after meals, is said to have the effect of converting the uric into the hippuric acid, and consequently the comparatively insoluble urates into the hippurates—comparatively soluble.

Destruction of Cartilage.

This may be either simple or scrofulous. It may be the result of absorption, ulceration, or local death; ulceration is by far the most frequent agent of removal. Sometimes all these are combined; following the order, as to time of operation, in which they are here stated.

The morbid action may originate in the cartilage; then it is usually quiet, insidious, and slow in its first progress. Or the affection of that tissue may be altogether secondary; the result either of advanced synovitis, or of structural change proceeding from the cancellated texture of the articulating extremities of the bones; in either of such cases, the cartilaginous invasion is rapid and acute.

I. SIMPLE DESTRUCTION OF CARTILAGE.—When original, this is almost invariably a leisurely process; and it may be conveniently divided into stages. 1. The texture becomes vascularized. There seems little doubt that the articular cartilage, in its normal state, is non-vascular. But to its undergoing the ordinary morbid processes, especially that of ulceration, it is natural to suppose that its permeation by blood-vessels is essential; and it has long been understood that vascularization accordingly does occur, as a preliminary and indispensable change. What was matter of inference, has lately been made matter of demonstration, beautifully illustrated by injection of the morbid tissue, by Mr. Liston.* This vascularization is to be regarded as the result of simply perverted nutrition, or the inflammatory process in its very lowest and primitive grade; causing softening and enlargement of the tissue, and attended with but slight feelings of uneasiness. 2. While vascularization is being accomplished, or speedily after its attainment, interstitial absorption is in progress. By this the cartilage—soft and tumid from the process of vascularization—is sometimes thinned, but more frequently only opened up in texture; and, as it were, rendered a suitable and unresisting victim to the coming ulceration. 3. Continuous absorption may now occur, and frequently does, causing loss of substance; usually commencing on the free surface of the cartilage; and unattended by any purulent or even puriform secretion. 4. The

* Medico-Chirurgical Transactions.

foregoing state of matters may exist for weeks, or even months; weeks, however, or days, being usually the more suitable for computation. Then true inflammation becomes established. Ulceration ensues; rendering loss of substance more direct and rapid; attended with purulent secretion, more or less profuse—now occurring for the first time; and accompanied by marked accession of pain, and other ordinary signs of the inflammatory crisis. The ulceration may either partake of the chronic nature which has hitherto characterized the morbid process, extending slowly; and, even after some considerable time, producing an ulcer, or ulcers, of but limited dimensions, the major part of the tissue remaining entire. Or it may assume an acute character, and speedily involve the whole, or greater part, in destruction.

The vascularization may be begun by the investing synovial membrane, by the subjacent bone, or by both. And these originally vascular textures, as a preparatory step, themselves undergo the chronic and minor grade of the inflammatory process; becoming thereby slightly tumid, and considerably increased in vascularity. According as either is the main agent in the initiatory change of the cartilage, so it is probable that on the corresponding aspect of that tissue the absorptive and ulcerative loss of substance will be begun; the ulcer advancing either from the surface towards the subjacent bone, or in the opposite direction. The former is the more common course; whence we would infer that the synovial membrane—changed at that part by increased vascularization, apparently on very purpose—is the chief agent in the destruction of the cartilage. And, even when the progress has been from beneath, there is little doubt that slow vascularization and turgescence of the synovial membrane are of early occurrence; so that when the true inflammation has been established in the hard articulating textures, the soft are abundantly ripe for sharing therein.

The characters of the ulcer may vary according to its extent. When limited, it is often of a circular form, and seeming as if a chemical erosion of the tissue had there occurred; without any sign of attempted repair. When the tissue has been perforated, the subjacent bone is exposed; and the characters are those of ulcerated bone surrounded by irregularly disposed cartilage. The synovial membrane, in the immediate vicinity, is red, swollen, and pulpy; plainly undergoing inflammatory change of structure. The parts most prone so to suffer, are those most liable to pressure—for example, on the inside of the head of the tibia, and the corresponding points of the condyles of the femur.

Healing may occur in different ways. 1. In the superficial and limited forms, there is an effusion of plasma, on subsidence of the ulcerative and inflammatory action; mainly contributed, it is probable, by the synovial membrane. This plasma becomes organized; forming a dense adventitious texture, not cartilaginous, which partially fills up the chasm; at the same time, by absorption of the margins, a smoothing or bevelling process is effected; and the new substance then becomes incorporated and continuous with the surrounding synovial membrane. A dense, firm, depressed cicatrix, with smooth and sloping margins, is thus produced. There is no reproduction of the cartilage. 2. When

the ulcer has penetrated to the bone, and also perhaps involved that texture somewhat, a similar cicatrix results; but with this difference, that the new matter is not furnished by the soft textures but mainly by the hard. The bone then throws out plasma; osseous nodules result therefrom, and occupy the exposed surface of the bone. These do not rise to fill the chasm, but remain limited and low, becoming smooth and rounded off on their surface. Exterior to this new osseous layer, there may or may not be a plasma from the synovial tissue, becoming organized, and, constituting the medium of incorporation between the hard and soft parts. 3. Or there may be no depression of the cicatrix, and no investment of it by adventitious soft texture. The exposed bone may furnish a greater amount of new matter, which attains to a higher level, than in the former case; at the same time the surrounding cartilage becomes attenuated by absorption; in consequence, the new osseous formation comes to be on a level with the surrounding surface, and there grows dense and compact. There is no investment of this by reproduction of synovial or other soft texture; itself has to bear the friction of the opposed surface, on resumption of function; and, as if in order to be able to discharge that duty to the utmost of its ability, it becomes unusually dense and smooth on the surface, by deposit of earthy matter of a peculiar kind, termed porcellaneous—the surface, which is thereby formed, proving smooth and fine as that of porcelain. This is doubtless inferior to the elasticity of cartilage, and the lubricity of its investing synovial membrane, but yet is a wonderfully efficient substitute. 4. Or the healing process may yet be of a fourth kind. Often deep ulcers of cartilage exist at opposite and corresponding points of the articulation. From these, osseous reproductions, springing up, are not unlikely to coalesce, causing fixity of the joint by ankylosis.

Sometimes death of cartilage, in continuous mass, complicates and aggravates the process of ulceration. In such cases, doubtless, the initiative has been in the subjacent bone; ulceration has thence begun on the deeper part of the cartilage, and may have extended much more in a horizontal than in a vertical direction. Thus a portion of the cartilage becomes attenuated and undermined; and, following a like course with skin, or any other texture similarly circumstanced, dies. By continuance of the ulceration, the dead portion is ultimately detached; and, becoming loose in the joint, adds, to the mischief already there, what is sure to result from the presence of extraneous matter within an inflamed synovial cavity.

The *symptoms* of such change of structure in articular cartilage are very distinct from those of affection of the synovial membrane. With ordinary care, they need never be confounded. As already stated, in the advanced stage of joint-disease, when all textures are involved, there is no means of ascertaining by present symptoms the original and chief seat of the malady; but while the morbid action is advancing in one texture, and as yet limited to that, the diagnostic signs of its presence and nature are usually plain enough. Be it remembered, however, that the symptoms of ulceration of cartilage, although invariably indicative of that affection, are not always indicative of its

amount, because not uniformly proportioned thereto. Sometimes we find much greater annoyance, both constitutionally and locally, from a single small erosion, than from a wide expanse of destruction.

The symptoms are found to tally well with the chain of pathological events formerly stated. At first there is dull and deep uneasiness in the part, with some impairment of motion; but without swelling or other apparent change of structure. This state may continue for days, or even weeks, with but little change; it corresponds to the period of vascularization and commencement of absorption. The uneasy feelings become more marked, and are aggravated nocturnally; absorption, both interstitial and continuous, is in progress. The pain is undoubted; deep, constant, worse at night; usually referred by the patient to one particular spot deep in the joint, and likened by him to the unceasing gnawing of an animal there. This is the period when absorption is becoming, or has become, superseded by true ulceration. Acute pain comes with the advance of the inflammatory process towards its crisis, and keeps pace with it. It is aggravated by motion, more especially if great and sudden; and, on gentle movement of the part, a grating sensation is ultimately perceived, in consequence of exposure of opposing points of bone. Very frequently there is a sympathetic pain complained of, sometimes fully as much as that in the part—an example of irritation in one part, induced by inflammatory change of structure in another. Pain in the knee, for example, is usually the most prominent symptom of disease in the hip; pain in the leg, may mask ulceration of the cartilages in the knee. The whole of the limb beneath the affected joint is usually both functionally and vitally weak; feeble and tottering; of diminished temperature, and inclined to œdema.

Wasting of super-imposed muscle is often both a prominent and early symptom of articular disease; atrophy of the deltoid, for example, may be the first to betoken ulceration of cartilage, of bones, or of both, in the shoulder; and flaccidity of the glutei does the same in regard to morbus coxarius. In the child, however, we must be on our guard against mistake on this point; inasmuch as muscular atrophy not unfrequently occurs, in early life, altogether unconnected with articular disease; dependent on dentition, or on intestinal irritation.

Swelling does not appear till uneasy sensations have been present in the joint for three or four weeks, it may be for months. It follows the steady aggravation of pain which indicates the advance of the inflammatory process, and its approach towards true ulceration; and is both less bulky, and less rapid in its formation, than that which attends on synovitis. It is composed of two parts; one internal, caused by gradual distention of the synovial pouch by slowly accumulating pus, now for the first time begun to be secreted; another external, by interstitial effusion in the textures exterior to the joint, these being now involved in a tolerably active sympathetic action. In consequence of its double and gradual nature, the peculiar bulgings dependent on the natural conformation of the joint do not occur; a diagnostic mark between this affection and chronic synovitis. In acute synovitis, swelling is tolerably uniform; but at the same time it is great, rapid, and coeval with the occurrence of pain; whereas in ulceration of cartilage, it is slow,

gradual, never great, and long subsequent to the feeling of uneasiness in the part. In chronic degeneration of the synovial membrane, on the other hand, the swelling is slow, and somewhat uniform, like that of ulceration; but still it is coeval with uneasiness, and elastic, doughy, and superficial—not deep and obscurely fluctuating, like that of ulceration. The latter swelling too, is intolerant of pressure, pain being thereby much increased; the other, on the contrary, is capable of bearing manipulation with comparative impunity.

After the swelling has become fully established, the inflammatory action is seldom long limited to the cartilage, but involves all textures. Pus accumulates; deposit and change of structure take place in the synovial membrane and textures exterior; ultimately, by ulceration there, the fluid escapes from the joint, makes its way to the surface, and is thence discharged; not without loss of substance in the ligamentous texture, as well as relaxation of that which retains its integrity, causing extreme laxity of the articulation. In consequence of this laxity, the joint, which previously had assumed the position of semiflexion, as in affection of the synovial membrane, may become wholly luxated; the flexor muscles having then to encounter but little opposition to their displacing force; and ordinarily there is also more or less rotation, or other displacement, one muscle, or set of muscles, exerting a supremacy of power. Thus, in such affection of the knee, the bones of the leg are dislocated backwards into the popliteal space; and at the same time the head of the tibia is usually rotated outwards, by the preponderating action of the biceps flexor cruris.

Such important local changes are not unattended with sympathy of the system. At first the general symptoms are but slight; little more than general discomfort, or slight feverishness, being complained of. But when pain becomes undoubted and steadily crescent, inflammatory fever is declared with more or less intensity; usually accompanied by involuntary startings of the affected limb—especially during sleep—by the jarring and motion of which, pain is fearfully aggravated, and the inflammatory action hurried on in its destructive tendency. Ultimately, in the open, lax, discharging, perhaps dislocated state of the part, hectic is inevitable.

The *results* are various. Resolution may occur, ere ulceration has been reached; absorption alone having followed on the vascularization, and having given way to rest and counter-irritation. Or the ulceration, having occurred, may prove but slight and transient, and function be restored; the breach being closed in one or other of the ways already noticed, and the trifling purulent secretion, with ulcerative debris, having been absorbed. Or osseous reproduction may prove excessive, occasioning true ankylosis; the limb being retained, but permanently maimed in the function of its articulation. Or the inflammatory destruction may ultimately become both so general and so great, and the constitutional sympathy so formidable, as to banish all hope of saving the part, even with impaired form and function; compelling us to direct our attention solely to the saving of life, by dooming the member to early amputation.

The affection may be idiopathic. More frequently it is attributed to

external injury ; perhaps slight ; probably neglected. Exposure to cold, too, is favourable to its induction ; as are both the mercurial and syphilitic taints of system. It is more frequent in the adult, than at an early age.

Treatment.—The obtaining of a complete immunity from all motion, by the adaptation of splints, is the paramount indication from the beginning to the end of the period of cure. Local depletion is had recourse to ; partly on its own account, but chiefly as preparatory to counter-irritation, which is doubtless entitled to the first place among the directly remedial agents. The vesicant form of counter-irritation, we found to be most suitable for affections of the synovial membrane. In this disease, a higher grade, the pyogenic, is required. Issues are the form generally in use ; and they may be established by either the potential or the actual cautery ; the former is in the greater number of cases equally effectual as the latter, and, being the milder in application, is therefore to be preferred. But in the larger joints, and in others where mild means have already been ineffectually used, let the graver remedy certainly be employed. The cure is invariably tedious ; and, consequently, the counter-irritation, with other means tending to its attainment, require to be patiently continued. It is not enough to establish an issue, and then leave it to heal or not according to circumstances. For some time, often considerable, the irritation and discharge must be continued from the surface ; and this may be effected in one of two ways, either by forming a succession of fresh issues, or by maintaining an open state of the one originally made. The latter method is most commonly followed ; equally effectual as the other, less troublesome to the surgeon, less painful to the patient. The discharging surface is dressed from time to time with some irritating ointment or lotion, as the savine, tartar emetic, &c. ; or it may be retouched occasionally by the potass or other caustic. This last mode of refreshing the sore is probably the best ; the inflammatory re-accessions, thereby induced in the surface, being of service, as well as the maintenance of sufficient purulent discharge ; it is generally our object not to obtain either counter-irritation or evacuation alone, in these cases, but a combination of both. Also, let us at all times beware of placing the artificial sore too near the joint ; otherwise we shall fail in counter-irritation, and apply a direct stimulus to the morbid action. Constitutional treatment is at the same time conducted, according as circumstances may demand ; at first antiphlogistic, afterwards cautiously roborant. When, in the early stage, much pain and spasm exist, full opiates are indispensable ; as the continuance of either must inevitably lead to aggravation of the disease.

In the more favourable cases, such treatment is slowly followed by gradual amendment ; the pain abates, and ultimately ceases ; the constitutional symptoms also disappear ; swelling yet remains, but softer, indolent, and infinitely less painful, even on pressure. When this state of quiescence has been reached—action having ceased, and its results merely remaining—the counter-irritation is to be desisted from. The issues are allowed to heal ; the splints are retained, still to control motion ; and pressure by the method formerly mentioned, is had re-

course to, in order to hasten absorption of deposit, and consequent return to the normal state. At first, however, pressure must be applied with especial caution, lest accession ensue; and if this threaten, the original treatment must be at once renewed. When not only action, but its products also, have been removed, motion is restored; but not till then; passive at first, gentle, and brief; at once desisted from on the occurrence of serious and continued pain. A certain degree of uneasiness invariably attends on resumption of motion, however cautiously conducted; but that is not to deter from perseverance in its use. Only when the sensation is that of undoubted pain, deep and constant as before, not in any marked degree diminishing on cessation of the motion, are we warned of danger from premature employment of the last item in the cure; and such warning, at all times sufficiently plain, we are never to neglect. The splints are again resumed; as well as leeches and counter-irritation if need be; and all movement is as scrupulously avoided as before; otherwise back will come the ravages of renewed disease, perhaps in an aggravated form. Such intercurrent inflammatory accessions are by no means unfrequent; and not always the result of malapraxis. They sometimes supervene on the quiescent state of the joint, without any assignable cause; but however induced, they are invariably to be met by a corresponding vigilance and propriety of treatment.

In the open condition of the ulcerated joint, cure is by no means hopeless. The probability is that motion will be permanently impaired to a certain extent; but we have usually good hope of retaining the part; amputation, now-a-days, is not the rule but the exception, even in this class of cases. After the establishment of the open state, not unfrequently the morbid action advances with increased virulence for a time, as formerly stated; and this exacerbation, expected, is to be met and subdued in the ordinary way. Afterwards, by rest, constitutional treatment, and, if necessary, counter-irritation—in addition to the evacuant remedy which has spontaneously formed—the quiet condition is attained. And then the treatment by compression will often be followed by the happiest results; subsidence of swelling, gradual disappearance of all uneasy sensations, closure of the apertures, and diminution of the discharge. The compressing apparatus is applied in the ordinary way; and does not require unusual frequency of renewal, the discharge in the truly quiet condition of the joint—to which state alone such treatment is applicable—being inconsiderable, and not tending to accumulate beneath the dressing, injuriously. Under such circumstances, however, it is expedient to abstract all mercurial ingredients from the ointment and plaster, otherwise a constitutional influence may be induced unnecessarily by that mineral; the open state of the part being most favourable to absorption. After satisfactory amendment under the compressing plan, motion is to be cautiously attempted. In some cases, we may succeed in restoring it completely; in others, it is incomplete, stiffening being to a certain extent insuperable, partly from alteration in the joint itself, partly from structural change in the ligamentous and other apparatus exterior; in not a few, motion is scarcely if at all resumed, true ankylosis having occurred.

See also, p. 20, on the treatment of the joint.
and the same result may be obtained by the use of the same

In some cases—but much more seldom than in the scrofulous destruction of cartilage and subjacent bone—there is no hope of cure, even by ankylosis. The disease will, as it were, accept of no compromise, but insists on complete disorganization of every texture. If the part be accessible—as the knee—it is to be removed by amputation, ere yet the system have been irretrievably involved in the downward progress; if inaccessible—as the hip—we can then only palliate what we cannot cure. The constitutional symptoms are to be subdued by the ordinary means. Locally, counter-irritation, as well as depletion, is not to be thought of; but rest is all-important. By the skilful adaptation of splints, so as to secure immunity from motion, yet without galling the part or annoying the patient, and not interfering with facility of dressing requisite for cleanliness, much amelioration is obtained. Life is not only made infinitely more tolerable, but may be protracted for even a considerable period. Even in the most hopeless cases, decided benefit will not fail to show itself; and in some, at first apparently irremediable, the amendment may be both so marked and so sustained, as not only to warrant the entertainment of a hope of cure, but even to carry that out to a tolerably successful issue; the joint may dry, and stiffen, and be consolidated—both life and limb retained.

In any case of urgency, whose circumstances point to early amputation, it behooves us to consider, before determining on that extreme measure, that it is possible the counter-irritant treatment may have been carried too far, and that this may be the cause, at least in part, of both the local and constitutional aggravation. Accordingly it is expedient, in the first instance, whenever circumstances permit, to abandon all active treatment—allowing the issues to heal, and maintaining absolute rest of the part with due regard to the system—and to let an interval of repose declare whether the urgency has arisen from the progress of the disease, or from excessive action of the means of cure—intended counter-irritation having proved directly irritant to both part and system. If the issues have been in fault, the symptoms will satisfactorily subside, during this interval; amputation, in consequence, is not only deferred, but may be rendered altogether unnecessary. If, on the other hand, no amendment follow the cessation of active treatment, amputation is unhesitatingly performed.

In those cases, in which cure is slowly advancing by ankylosis, it is very important, with a view to the future usefulness of the limb, to have regard to the position of the joint. In the elbow, for example, we will prefer neither complete extension nor extreme flexion, but an intermediate rectangular position; the limb, when so fixed, being most favourably disposed for prehension. The spontaneous flexion of the knee, on the contrary, will be gradually undone, and yet full extension not desired; the limb, when slightly bent, so as to permit the weight to rest on the ball of the foot, being the posture most suited for progression.

When cure has resulted, with fixity of the joint, whether in a favourable position or otherwise, a question arises as to the propriety of attempting to overcome the rigidity and restore motion. When ankylosis is osseous and complete, the question may be unhesitatingly answered in the negative. Disruption of the osseous interlacement

could only be effected by violence, such as inevitably to induce inflammatory action, probably of a grave kind, in a part whose power of control has been greatly impaired by previous and recent disease; the process of disorganization advances anew, and the joint is lost. When, however, the ankylosis is spurious, dependent on structural change in the soft parts exterior to the joint, restoration of function is to be attempted cautiously, yet with determination, by the ordinary means—to be considered, when treating of ankylosis.

True ankylosis having been undeniably and hopelessly established, still a question may arise, whether or not the part is beyond the reach of our remedial art. The original joint being thoroughly obliterated, and all the textures enjoying a complete immunity from perverted vascular action, may not an incision be made immediately beneath the stiffened joint, the bone be there sawn across, and the case subsequently treated so as to establish there a false articulation—inferior doubtless to the original, yet still capable of assuming at least some of its functions and utility? This has been practised by Mr. Barton, of America, with success; section of the neck of the femur having been made in a case of ankylosis of the hip-joint. But further experience is yet required, ere such procedure can be said to be as expedient in practice as feasible in theory. And even supposing that its general safeness shall have been established, it would yet remain obvious that all joints are not amenable to the experiment.

Acute Ulceration of Articular Cartilage may be either original or secondary, as to texture. That is, it may either be an accession on the more common chronic form, originating in the cartilage itself, by the slow and gradual process just detailed; or it may follow on disease of the synovial apparatus, the cartilage having been in the first instance altogether unimplicated in the morbid action. In the latter case it is probable that, during the progress of the synovial disease, the cartilage has been sympathizing to such an extent, as to favour the occurrence of its vascularization; and that so a predisposition to the assumption of morbid action is established in the previously non-vascular tissue. Then, suppuration having occurred within the joint, by the advance of the synovial affection, we can readily understand how ulceration of the cartilage should follow; pressure by the accumulating pus then acting on a part, which is both capable of, and predisposed to obey excitement to, acute vascular action. The ulceration that follows is usually both acute and extensive; not unfrequently accompanied with partial death of the cartilage; this aggravating all the symptoms, and accelerating the joint's disorganization. It may be, that after evacuation of the purulent formation, in the open state of the joint, all action in time subsides; the secondary affection of cartilage and bone may then abate, as well as the primary disease of the soft parts; and hopes of cure may be reasonably entertained. But it is plain that cure, under such circumstances, can be only imperfect—by ankylosis; the ulceration having been both too wide and too deep to admit of simple cicatrization.

Could we always be certain of the signs of acute suppuration in synovial affections, an early incision might often arrest, or at all events greatly limit, secondary acute ulceration of cartilage. But, unfor-

tunately, we are seldom satisfied of our diagnosis, until some time after the event; when the matter has collected in considerable quantity, and is already approaching the surface with a view towards its own evacuation. Our duty then is to evacuate; to soothe the excitement which will necessarily follow the wound, by rest, and by antiphlogistics proportioned to the exigencies of the case; and by subsequent continuance of rest, and employment of the higher grades of counter-irritation, to endeavour to arrest the ulceration which we have not been able to avert.

II.—SCROFULOUS ULCERATION OF ARTICULAR CARTILAGE.—This may originate in one of two ways. It may follow on the chronic gelatinous degeneration of the synovial membrane. Or it may be the result of scrofulous disease in the cancellated texture of the articulating extremities of the bones; at first chronic; ultimately acute and rapid in its destructive progress. The latter is the more frequent, and by far the more formidable affection.

In the former case, there are at first the ordinary symptoms of the indolent scrofulous degeneration. Then pain, deep-seated and severe, supervenes; the constitution seems inclined to assume a more intense and sthenic form of sympathy than before; the swelling increases, and there are undoubted signs of roused activity in the part. Ultimately the swelling grows fluctuating, denoting that pus has formed in the joint; this seeks the surface, and is discharged; and then the work of disorganization is likely to advance, till all the textures have been irreparably involved. In the advanced stage, the joint becomes peculiarly lax; previously, it was rigid and comparatively motionless; now it may be moved freely in any direction, and that with comparatively little pain; partly from destruction, partly from relaxation of the ligamentous and other textures exterior. Luxation consequently is not unfrequent, in the end.

Or the indolent stage may continue, while yet the cartilage is extensively removed; this being effected, not by ulceration, but by absorption. True ulceration is, however, at all times prone to supervene—perhaps under the influence of some trivial exciting cause, as a slight blow or wrench—along with suppuration and its usual results.

When the morbid action originates in the cancellated texture of the articulating extremities of the bones, there is usually a considerable period of comparative repose. Tubercular deposit gradually occurs, filling the cancelli; accompanied with dull aching in the part, swelling, and impairment of function. The bone at that part manifests enlargement; partly real, in consequence of a certain degree of expansion, induced by the tubercular infiltration; chiefly apparent only, on account of the atrophied condition of the muscles and other soft parts. To this condition the term “white swelling” may perhaps be most truly applied; the joint being large, weak, and deformed; and the skin, sometimes showing large veins beneath, being stretched over the deep swelling, of a pale white hue. The infiltration of the soft parts exterior to the joint is not by serum, but by solid fibrinous deposit; the result of chronic, not of acute sympathetic action; the work not of days, but of weeks, perhaps of months. After this state has existed for some time

—perhaps for months—exacerbation takes place; pain is greater and more constant; motion is denied; swelling of the soft parts is greater, and more apparently the result of an inflammatory process; sleep is disturbed, and the spasmodic twitchings threaten; the constitutional symptoms are aggravated, and for a time display the ordinary characters of smart inflammatory fever—modified, it may be, by the previously existing cachexy. The commencement of this exacerbation is coeval with suppurative disintegration of the tubercular deposit in the cancelli; its crisis corresponds to purulent irruption into the cavity of the joint, the matter having made its way thither by means of ulcerative destruction of the intervening bone and its cartilage. Not unfrequently necrosis is combined with the ulceration, and dead portions of the cancelli lodge in the articulation. Then the ordinary ravages ensue; inflammation, suppuration, and ulceration, beginning in the bone and cartilage, but forthwith invading every texture; and usually destroying all, with a rapidity proportioned to the diminished power of both part and system.

Sometimes scrofulous disintegration of the articulating extremities occurs, without any apparent previous deposit of tubercular matter in the cancelli. These often suppurate, crumble down; and the ill-digested matter, mingled with the debris, makes its way, either exteriorly, to the surface, or into the joint—or in both directions—and the usual train of symptoms ensue; all announcing the scrofulous character of the case, the scrofulous origin of the morbid action, and pointing to the unfortunate issue which such affections usually produce.

The joints most prone to suffer, are those in which the cancellated texture enters most copiously into the composition of the articulating ends of the bones.

Either form of the scrofulous destruction of cartilage, inasmuch as it depends mainly on the vice of system, is liable not to remain limited to the joint originally attacked; but to affect several, either at once or in succession. For a like reason, the disease is most frequently met with during the period of adolescence.

Treatment.—Our principal object, in the early stage, is prevention. In the case of the gelatinous degeneration, to effect arrest and resolution of the morbid process, ere the cartilage have been involved; when its vascularization may have been begun, but when as yet the truly morbid process is only threatened. In the tubercular infiltration, to preserve that in the crude state, and if possible to obtain its absorption; averting the softening and suppurating process; or at all events limiting and moderating it; and perhaps, should it occur, preventing its invasion of the joint's interior. Rest, maintained by splints, absolute, and constant; moderate local depletion; counter-irritation, of the higher grade, patiently sustained, and cautiously conducted, as to time, place, and mode, so as not to overact its part; judicious and persevering employment of such remedies as are best adapted to overcome or palliate the scrofulous diathesis:—these constitute the means of treatment.

When suppuration has occurred and ulceration become established, the general principles of surgery are to be sustained. By timely incision, the purulent fluid is to be effectually evacuated; that we may if

possible limit what we cannot avert. The subsequent symptoms are to be palliated, by every means in our power, both general and local; and cure by ankylosis hoped for.

In those cases, in which it is plain the part cannot be saved—and in this, the scrofulous form of open joint, unfortunately these do not constitute the minority—amputation is naturally looked to as the only source of hope; that by sacrifice of a part, a mutilated whole may still be saved. But careful inquiry and reflection are necessary, ere this resource can be duly determined on; otherwise it may happen, that by removal of a part we do not succeed in preserving the whole, even for a time, but on the contrary greatly accelerate its decay. It may be that the frame is irrevocably the victim of the tubercular cachexy, and doomed sooner or later to perish thereby; but for the time relieved or sustained by the breaking out of a drain, or safety valve, in the suppurated scrofulous joint, whereby the injurious deposit is extruded, with comparative impunity; exhausting the system in one sense, it is true, and inducing marked hectic, under which vital power must ultimately be prostrated; but still keeping back the more formidable obstacle to life, of tuberculated deposit in an internal organ—lungs, liver, kidneys, or all. Such deadly internal disease may be only threatened as yet; then the open joint may delay its invasion. Or the phthisis may be already plain; still the local discharge, if free and constant, may moderate or even stop its onward progress. Whereas, should amputation be performed, and should the wound dry and heal; the probability—nay, almost the certainty is, that the internal and more serious disorder will sustain a mighty and altogether uncontrollable aggravation; and, inducing a far worse form of hectic, hurry the patient fast into the grave. With the open joint, he might have lived for months, in comparative ease; without it—supposing the operation to be in all respects locally successful—days, or weeks at most, will see his doom. Ere amputation be definitively resolved on, therefore, let there be a careful review of the patient's past history and present circumstances; let the state of the internal organs—more especially the lungs—be diligently inquired into; and if these appear free from tubercular disease, as well as from strong predisposition thereto, let the operation be undertaken, hopeful of success; but if, on the contrary, the internal organs be plainly already involved, and that seriously, let us by all means refrain from amputation, and content ourselves with palliation of the more distressing and urgent symptoms. When there are strong marks of predisposition, but yet no decided evidence of the internal disease, expediency of operation is at all times doubtful; and the question can only be rightly resolved by deliberate use of judgment and experience. When amputation is performed, immediate union of the wound by adhesion is plainly not desirable; sudden drying up of the long-continued discharge might seriously incommode the system; we seek suppuration and granulation, and, by that mode of healing, have a gradual transition to local soundness.

In acute synovitis, we found that the free internal use of mercury, so as to produce its constitutional effect, was in many cases advisable in order to save texture. In decided simple ulceration of cartilage,

also—more especially of the acute kind, or tending to assume that character—its use may be expedient. But to this scrofulous degeneration of cartilage and bone, we deem it wholly inapplicable. The scrofulous system has no tolerance of the remedy; attainment to the locally beneficial effect is more than doubtful; and the unguarded attempt is likely either to fail in its object altogether, or only to achieve it imperfectly, while at the same time the system receives a severe injury, perhaps irreparable.

Hypertrophy of Cartilage.

Articular cartilage, like cuticle, a non-vascular tissue, may become preternaturally developed, either generally, or only at certain points. The parts most prone to undergo this change, are those where pressure is habitually the least; as on the patella. Whether this occurs by increased nutrition on the part of the subjacent bone and investing synovial membrane; or whether the cartilage has become slowly vascularized, and itself effects its own hypertrophy—seems yet to be uncertain. The free surface is often less smooth and polished than in the normal state; dull, and almost villous in its aspect. The affection may occur at any age. The symptoms are obscure; dull uneasiness, perhaps a very slight degree of swelling, impairment of motion, and a feeling of weakness in the part. The treatment will consist of rest, the minor forms of counter-irritation, and attention to the general health; the iodide of potassium is likely to be of use, both externally and internally. Afterwards, friction, and support of the part by bandage, or by the elastic yet close-fitting knee-cap, will be advisable.

Atrophy of Cartilage.

This occurs chiefly in the old, at the points habitually most compressed; and the aged who have led a laborious life, much in the erect posture, are the most prone to suffer. The joints of the lower extremity, especially the knee on its inner part, are the most frequently affected. Not unfrequently, rheumatism seems to be concerned in the change. At first the cartilage seems to be opened up in texture, the absorption being decidedly interstitial; afterwards the normal density is resumed, but with diminished bulk. The cartilage may be merely thinned, in stripes or patches, continuous or detached; or it may be wholly removed, exposing the subjacent bone; this latter tissue however is usually entire, giving way neither by absorption nor by ulceration, but tending, on the contrary, towards reparative action. The symptoms are, like those of the opposite condition, obscure; rigidity, crackling sensation and noise in attempted motion, rheumatic pains, tendency to occasional puffiness by superficial cedema; inability long to maintain the erect posture, and still less to bear any considerable weight. The principal treatment will consist of kindness to old age; local support by bandaging or knee-cap; and perhaps complete rest, with light counter-irritation, for a time, should the symptoms prove unusually urgent, and the inflammatory process threaten to supervene.

Long confinement and severe local remedies are inexpedient ; for it is not to be expected that the atrophy will be so arrested ; and the general health would surely suffer.

Porcellanous Deposit.

This may be the result of ulcer in the cartilage ; one mode of reparation being by the aid of dense deposit, assuming a vivid polish, as formerly explained. But more frequently it follows on the foregoing affection, atrophy. The bone is exposed, by the gradual removal of the super-imposed cartilage ; and then, the absorbent action usually ceasing, a restorative is begun. New cartilage cannot be produced, but a very efficient substitute may ; a texture not soft, elastic, and finely lubricated ; but dense, smooth, and of the finest polish. In some cases, the open areolated texture of the exposed bone is retained ; as if this had merely become so condensed and polished on its very surface, by dint of pressure and friction ; but more frequently the existence of new deposit is plainly evinced, by closure of the areolæ, and the glistening surface is presented compact and unbroken. Very frequently the opposing porcellanous surfaces—as of the tibia and femur—fit into each other by grooves and ridges ; and thus motion becomes not only crank but limited. Deposit of osseous matter exterior to the joint is also not uncommon ; another serious obstacle to function. Contrary to what might be naturally inferred, the new formation is found to contain a less proportion of earthy matter, than does the ordinary bone.

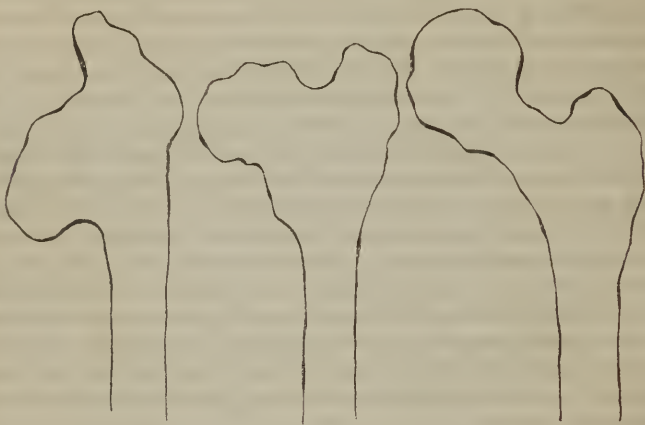
The symptoms are similar to those of the most usual cause—atrophy of cartilage ; with the addition, frequently, of a distinct grating and jarring sensation, felt on sudden motion. The treatment the is same. The rheumatic diathesis is often co-existent ; and may fairly enough be blamed, at least in part, for the occurrence of the change of structure.

Osseous Deposit Exterior to the Articulation.

This may be the result of rheumatism, affecting the part, more especially the periosteal investment of the articulating extremities of the bones, as formerly described. Or it may, like the two last affections, be rather the mere concomitant of old age ; analogous to the ossification of cartilage, as in the ribs, and trachea. To the latter form, the hip-joint is especially liable. The ligamentum labri cartilagineum becomes ossified, deepening the acetabulum, locking the head of the bone, and greatly limiting the movement of the articulation. Dislocation is rendered impossible, without giving way of the elevated brim of the acetabulum ; but fracture of the neck of the femur—a more formidable accident—is on the contrary favoured. At the same time, the bone around the acetabulum is often studded, more or less copiously, with osseous nodules of recent formation. Such a state of matters is obviously not amenable to treatment with the hope of cure. It is sufficient that the duties of the part shall be made to correspond to its modified powers of performance ; exposure to casualty by external violence being at all times sedulously avoided.

Interstitial Absorption of Bone, Implicating the Joint.

This also applies especially to the hip-joint. In consequence of external violence, as a smart blow, or fall on the trochanter major, it is not uncommon to find the neck of the femur undergo much change by interstitial absorption. And similar alteration may occur, spontaneously; that is, without any assignable cause; seeming, like some of the affections last noticed, to be one of the many signs of the frame's decay, not only in mass, but in its details, which usually accompany old age. This idiopathic form is perhaps most frequent in women, the greater



length and rectangular position of that part of the skeleton in them, seeming to predispose thereto. The neck of the bone is shortened; the head approaching the trochanter, till at length it seems to be set on there, without any intervening neck at all. At the same time, the angle is changed; the natural obliquity upwards becoming altered, first towards the rectangular position, and ultimately the head of the bone descending to form an angle of a precisely opposite kind. The degree of shortening varies, from half an inch to two or even three inches; and the lameness is in proportion.

The head of the bone itself usually undergoes some change, partly by absorption, partly by irregular deposit on its articulating surface; sometimes also it is studded by the porcellaneous formation.

Practically, the occurrence of such change becomes of the greatest importance. For example, suppose that an elderly man sustains contusion of the hip by a fall, and is taken up lame. Fracture of the hip-joint is naturally suspected; but on a very careful examination, the usual signs of this form of injury are found wholly wanting, and the surgeon is satisfied that the case is one of mere bruise only. The treatment is conducted accordingly. The attendant unaware of such change, in the relation of the head and neck of the bone to the shaft, being likely to occur, has not protected himself by his prognosis, and never thought of

fore-warning the patient and his friends, that by the occurrence of such change, the more prominent symptoms of fracture may by and bye be closely simulated. After three or four weeks of confinement on account of the results of the bruise—for in the aged such time is not unfrequently required for disappearance of the pain and lameness—the patient gets up, and attempts to walk; and then, for the first time, is noticed a shortening of the limb, which may vary from less than half to considerably beyond a full inch. The surgeon is surprised, and the patient is mortified, perhaps indignant; being naturally led to suppose that his case has been mistaken, and consequently mismanaged; that what was called and treated as a bruise, was after all a fracture. Whereas, had not only the possibility but the probability of such a change been both known and remembered, all would have been rightly understood and patiently submitted to; both the feelings of the patient and his friends, and the reputation of the surgeon, would have been uninjured.

Loose Cartilage (?) in the Joint.

Loose substances, usually of an irregularly oval form, are sometimes found loose within the cavity of articulations; and the joint by far the most liable to this affection is the knee. They are commonly termed cartilages; but according to Müller, this is a misnomer; their consistence being that of cartilage, but their structure distinctly fibrous. Sometimes they are of almost calcareous or osseous density. They vary in size from that of a pea to that of a prune; the average dimensions are those of a flattened middle-sized bean. The surface is generally smooth; but sometimes broken by slight nodosities. Most frequently they occur singly; and seldom more than two or three are found in any one joint.

It is probable that in three ways these substances may be produced.

1. By external growth. A fibrinous deposit takes place exterior to the synovial membrane; and as it enlarges, that membrane is pushed before it forming a close envelope. The little mass projects into the cavity of the joint, and is not unlikely to assume a pedunculated character. On a sudden movement, the peduncle may be severed, and the extraneous substance is thrown loose into the joint.
2. By internal formation, in the substance of the synovial membrane. A fibrinous mass may form in that tissue, analogous to the adventitious structures found in the "fimbriated" condition of the synovial apparatus, formerly described; but differing from such formations in being single, instead of gregarious; and ultimately becoming much more dense in structure. It is not difficult to imagine how such a formation, at first attached, may become separate, and float loose within the cavity.
3. By hypertrophy of the original cartilage. Joints—especially those of the elbow and knee—are not unfrequently found in Museums with marked and irregular enlargement of their cartilage, and also, in some degree, of the subjacent bone, at the outer rim of the cartilaginous surface; part of these excrescences may point towards the joint, showing more or less of the pedunculated form; portions may be found within the joint, some quite loose, and others yet adherent. Such preparations sufficiently indicate

the anormal process whereby this third mode of formation may be effected. It should also be observed, however, that such enlargement is not mere hypertrophy of the original cartilage; the texture is changed, becoming infinitely more dense and fibrous; and it is a portion of this so altered tissue which is projected and detached.

However occasioned, the symptoms are usually sufficiently distinct. At times there is no uneasiness; the foreign body remaining in a part of the joint removed from the play of the bones in progression. Suddenly, however, it may become dislodged from this retreat; and, coming between the ends of the bones, on an instant the most excruciating pain is endured; the limb is rendered rigid, and motion arrested, as if by a spell. And the distressing symptoms are not relieved, until by gentle flexion and manipulation, the intruding substance has been again placed in its unoffending position. Such occurrences, by frequent repetition, are themselves a source of much inconvenience and discomfort; and besides, they are not unlikely to prove the means of lighting up an inflammatory action, whereby the most serious consequences may ensue. It becomes an object of some importance, therefore, either to palliate the symptoms, or by removal of their cause, to dispel them quite.

Treatment.—When inconvenience is not much complained of—only occasional, then not very severe, and remedied with tolerable facility—treatment should be but palliative. For, operation is scarcely warranted; and puncture of such an important articulation as the knee is never wholly free from risk, however skilfully and carefully conducted. Furthermore, experience has fully proved that any operation, sakelessly although well performed, has an especial tendency towards an untoward issue. An elastic bandage, or tightly fitting knee-cap, is applied, and constantly worn; with the view of limiting the redundant body within its own domain—where remaining, it proves inoffensive. Should it accidentally escape, and become jammed between the head of the tibia and condyles of the femur, it is to be instantly replaced, and the apparatus resumed as before; and recumbency is advisable for a few hours afterwards, in order that all local excitement may wholly pass away.

Not unfrequently, however, palliation fails; the patient's life is rendered miserable, and himself unfit for active occupation; also organic disease may be threatened by the oft-repeated excitement. In such cases, the patient may urgently demand removal of the offending substance by operation; and fortunately, his request may be now-a-days agreed to, with a very fair prospect of success: the subcutaneous and valvular mode of puncture being adopted; the adaptation of which form of wound, to such cases, seems to have occurred simultaneously to two surgeons, Messrs. Syme and Goyrand.* In the first place, the patient is to be prepared for the operation. For a day or two the limb is to be disused, so that previous excitement may have thoroughly subsided; low diet is enjoined, the *primæ viæ* are gently yet efficiently cleared, and general secretion is seen to be in a satisfactory state, so that there may be no predisposition to inflammation. Then the foreign

* I am informed by my colleague, Dr. Duncan, that about the same time he also contemplated the subcutaneous operation in this affection.

body, having been made superficial, is gently pushed to the extreme verge of the synovial pouch, either on the inside or on the outside of the patella, as may be most convenient—the internal position is usually the preferable—and there retained fixedly by the fingers of an attentive and steady assistant. A tenotomy needle, or thin and narrow bistoury, of a fine edge, is passed in an oblique direction; and an incision, a little larger than the outline of the cartilage, is made through the tense synovial membrane. The instrument is then withdrawn slowly and cautiously, the finger gently yet firmly following on and consolidating its track; a few drops of blood escape, but not a particle of synovia; and no air has obtained admission, even to the cellular tissue. The integumental wound is immediately and carefully occluded, by the improved adhesive plaster. The cartilage is then gently pressed through the aperture in the synovial capsule; which aperture, as has just been stated, is made sufficiently free to admit of this being accomplished without force or difficulty. When exterior to the capsule, it is coaxed through the cellular tissue—sufficiently lax readily to admit of this—by gentle pressure of the fingers; not in the track of the puncture, but in a different direction, probably at nearly a right angle to it. When about an inch and a half, or two inches, from the synovial wound, it is there permitted to remain. Not permanently, however, as has been proposed; otherwise, acting still more as a foreign body in its recent and raw site, inflammatory action is excited, suppuration is all but inevitable, and extension to the synovial membrane becomes extremely probable—the very result to the avoidance of which all our pains had been directed. For two days, or three at the utmost, it is suffered to remain in its new locality undisturbed; the most careful prophylactic treatment being meanwhile employed, both generally and locally, so as to avert undue excitement. By that time the synovial wound will have closed by adhesion; and both tracks—that of puncture as well as that of extrusion—will have been consolidated. Then, the substance having been fixed as before, a direct incision is made upon it; not more free than is sufficient for its ready removal. After it has been lifted out, the superficial and slight wound is brought together by strap; and in all probability it unites by adhesion. For some time after the operation, the limb is kept rigidly immoveable, yet comfortably placed; splints being employed if necessary, in addition to well-adjusted pillows; and the most strict antiphlogistic regimen is enjoined. Immediately after the operation, antimony may be prudently given internally, in moderate doses; and cold is applied to the part—by evaporating lotions, or by simple water-dressing—so as to ensure the warding off of the much-dreaded inflammation. All bandaging, compresses, pledgets, and multiplicity of plasters are to be avoided, being likely to engender what we most seek to avert; as will afterwards be shown.

The operation, as we would advise it, is thus seen to consist of distinct parts. 1. The prophylactic preparation, occupying not less than several days. 2. The oblique valvular puncture, carefully preventing the entrance of atmospheric air, even into the superficial cellular tissue. 3. The extrusion of the cartilage into the cellular tissue, in a different route from that of the puncture; and lodgement of it subcutaneously,

at a safe distance from the synovial wound. The second and third parts of the procedure are accomplished at once, in immediate succession; and then two or three days, not more, are allowed to elapse, with a view to consolidation of the wounds. 4. By a direct incision, the offending substance is finally removed from its temporary abode. The reason why it is not at once taken away, through the original puncture, is, that it would be in most cases very difficult to accomplish this without the admission of atmospheric influence; the almost certain consequence of this would be synovial inflammation of an intense kind, ending in suppuration and loss of the joint. And, as experience has proved, it were alike unsafe to leave it unremoved from its secondary and subcutaneous abode; it being extremely probable that an effort would be made by nature to dislodge it thence, by the ordinary means of inflammation and suppuration of the textures around; and then we should probably be unable to prevent involvement of the synovial membrane.

By another mode a cure might be obtained. Were a patient averse to cutting instruments, and yet much annoyed by the disorder in question; or were any other circumstances to exist, rendering the propriety of even subcutaneous incision questionable; the foreign body might be permanently secured in a safe part, by transfixion. The same preparatory treatment having been employed, and the cartilage having been similarly fixed, by an assistant, in a favourable locality, a hare-lip pin, or finer needle, may be passed through the integument, so as to entangle the surface of the cartilage in its hold; or, should the consistence of the cartilage prove not great, it may be more completely transfixed. A few turns of a thread will suffice to keep the needle in its place. After a few days it is gently withdrawn; and rest, with antiphlogistic regimen, is strictly maintained. Sufficient excitement is induced for fibrinous effusion, of a plastic kind, along the track of the needle; and thereby the previously moveable substance is fixedly incorporated with the parts, becoming permanently resident where its presence can produce little or no inconvenience.

Destruction of Bone in Joints.

1. *Articular Ulcer.* This is connected with ulcer of cartilage. The ulceration may commence in the latter tissue, and thence extend to the subjacent bone. Or the bone may be first involved, and the cartilage suffer secondarily, partly by death and partly by ulceration. The loss of substance may be more or less extensive; but in this, the true ulcer of articular bone, it is seldom great. The symptoms are similar to those of ulcer of cartilage. So is the treatment; consisting mainly of rest and counter-irritation. According to the extent and progress of the disease, the cure will be by simple cicatrization, with or without the porcellaneous formation; or by ankylosis.

2. *Articular Caries.*—This more intractable, rapid, and extensive destruction of bone may be either simple, or preceded and accompanied by tubercular deposit. It may originate in ulceration of cartilage; the exposed bone being at first simply ulcerated, and afterwards degene-

rating into the true carious condition. Or the original disease may be the chronic gelatinous degeneration of the synovial membrane; the articulating ends of the bones becoming carious, on the establishment of the suppurative stage. Or the carious state may originate in the cancellated texture, cartilage and synovial membrane becoming secondarily involved; and then there is usually the precedence and co-existence of the tubercular deposit, the case being one of an obviously scrofulous kind. According to the mode of origin, the symptoms vary; assuming the type of one or other of the affections which have been described in the preceding pages. In fact, this disease may be practically regarded as the advanced stage of the three most formidable affections to which joints are liable; degeneration of the synovial membrane, ulceration of cartilage, and suppurative disintegration of the articulating ends of the bones—with or without the scrofulous cachexy.

In the treatment, three results may be looked to, as in ordinary caries. 1. The cure may be in a great measure spontaneous. On establishment of the open state of the joint, disintegration advances rapidly; thereby the carious surface may be wholly destroyed, a tolerably sound part remaining; and on this basis a reparative structure may be reared, sufficient for completion of the cure by ankylosis. 2. The foregoing result being plainly hopeless—yet the disease not being very extensive, the system not greatly depressed by the hectic cause, and the scrofulous cachexy either wanting or but slightly and chronically developed—the ordinary treatment for caries may be followed out. The diseased parts may be exposed by incision, and removed; the cure being subsequently either by ankylosis or by the establishment of false joint, according to circumstances. Such an operation is termed resection of a joint. 3. Or, both of the preceding events being plainly hopeless, and the frame yielding visibly before the hectic, amputation is the only remaining remedy; and, harsh though it be, it is our duty to avail ourselves thereof, unless when contra-indicated by the circumstances formerly detailed.

Resection of Joints.

Articular caries is the disease which demands this operation. The joints most suited to its performance, are the elbow and shoulder; the knee and hip seem well entitled to claim a special exemption—at least in the case of disease; in some cases of external injury, as will afterwards be seen, removal of the head of the femur is far from being an unwarrantable proceeding.

By free incision, the joint is cut into; and by cautious dissection the diseased parts are exposed to their full extent; then by the saw, cutting pliers, or both, not only the carious surface is removed, but also the soft, spongy, perhaps infiltrated, texture beyond. During the dissection for full exposure of the diseased parts, the knife's edge is moved warily in close proximity to the bone, so as to avoid unnecessary injury to the soft parts, especially the arterial and nervous trunks. The soft parts may be very much altered in structure; dense, pale, and swollen. Yet experience tells us, that it is altogether unnecessary to remove any por-

tion of them. On re-adjustment of the wound, smart inflammation ensues, pervading its whole track; a fresh and more vigorous suppuration is established; the altered tissues again change, and ultimately come to form healthy granulations, and otherwise contribute to completion of the cure.

The surgeon, when satisfied that a sufficient amount of the diseased bone or bones has been removed, replaces the soft parts, and retains them in contact by position and bandaging. Adhesion is not to be dreamt of; and accordingly the treatment need not be directed thereto. Inflammation and suppuration are awaited; and if threatening to prove excessive, means may be taken for their abatement. The reparative stage having fairly commenced, then an important question comes to be arranged; whether by occasional motion, the construction of a false joint shall be favoured; or whether by rigid immobility of the parts, secured by careful splints and bandaging, we shall seek for ankylosis. In the majority of cases, in which the operation has been judiciously had recourse to, the former procedure is the preferable. Experience has shown that motion, duly employed, is not only capable of inducing the formation of a very useful hinge; at first very flexible and weak, but gradually becoming firmer and of greater power; but also, that there is little risk of re-induction of the disease by inflammatory accession and its results. When, however, we have operated in a case in which the disposition to relapse is plainly marked, from the state both of the part and of the system, prudence will necessarily dictate the safer procedure, of favouring ankylosis; sacrificing motion, but retaining the limb, because securing immunity from return of the disease.

Mr. Syme, to whom the profession is much indebted for his successful exertions in this department of operative surgery, thus describes the condition of the limb, when a fortunate issue has ensued:—"It has been proved by numerous facts, that while the joints beyond the disease remain as useful as ever, the one which has undergone the operation regains such a degree of mobility and subjection to the action of its muscles, as sometimes to render it hardly distinguishable from a sound one, and in general prevents it from at all impeding the use of the arm by its stiffness. There is no new joint, strictly speaking, formed, but a strong fibrous substance unites the extremities of the bones, and by its flexibility allows them to move within proper bounds; while the muscles cut across in the operation obtain new attachments, so as to perform their usual office."

In determining on the operation of resection, it should invariably be well considered, whether there be a fair prospect of an issue in all respects prosperous, and but little chance of amputation being ultimately demanded by re-induction of the disease, probably of an aggravated and acute form. Otherwise, it were surely better at once to have recourse to the latter operation; a worn system, originally by no means strong, may have power enough to bear up under either resection or amputation; and may be certain to give way under a combination of the two. 1. The patient's age is an important point in such deliberation. For resection, he should be neither very young nor very old; if young, scrofula is likely to be much concerned in the disease—and not

of a quiet but of an acute, and as it were restlessly active, kind; if old, there may be want of restorative energy in the wound. 2. The system should not be much exhausted; otherwise, not only is the re-induction of disease favoured, by want of power, both locally and generally; but also it may happen that the suppuration in the wound continues to prove excessive, unaccompanied by efficient effort at reparation, and removal of the hectic cause by amputation may be imperatively demanded. The certainty of suppuration, profuse and perhaps protracted, and the chance of amputation following thereon, should never be omitted in our prognostic calculations. 3. By careful examination with the probe, and by manipulation, we should be satisfied that the disease is truly of no great extent beyond the mere articular extremities; for it is plain, that the removal of several inches of each bone—and unless all the diseased part be thoroughly taken away, the operation had better be unattempted—cannot be expected to be followed by even an approach to a cure in any way satisfactory, and ought to be superseded by the not more ruthless procedure of amputation. Regarding extensive involvement of the soft parts, we need be less anxious; they being capable of recovery under apparently very adverse circumstances, as already stated. 4. Finally, the more intense the development of the scrofulous diathesis, the more unfavourable the case for resection; and vice versa.

Anchylosis.

Stiffness of a joint, as can be readily understood from what has been stated, may depend on various conditions of the articulation and of the parts exterior. Accordingly, anchylosis is said to be of different kinds.

1. *Osseous* or *Complete*.—This is the result of ulcer; the osseous texture having been exposed thereby, and subsequently becoming engaged in an energetic effort towards reparation; the new osseous formation proves excessive, and the opposing bones become firmly united by incorporation. Or the anchylosis may be in a great measure independent of change in the interior, depending mainly on exuberant ossification on the external aspect; the joint becoming immoveably locked in the tight embrace of an outer case of bone, continuous and incorporated with the original tissue; the result of a chronic perversion of vascular action, of a low grade, and probably connected with rheumatism. Or both forms may be combined, the anchylosis being general and at every point complete; and almost all traces of previous articulation having become effaced.

2. *Ligamentous*.—The articular surfaces remain unincorporated at any part; but are kept in close union, and more or less immoveable, by alteration in the ligamentous apparatus exterior, which has become condensed, rigid, and non-elastic.

3. In the *Spurious* Anchylosis, there is neither amalgamation of the bones, nor much, if any, structural change of the proper ligaments of the joint; but fibrinous deposit has occurred extensively, exterior to both; the flexor muscles and tendons have become contracted and rigid; and from this cause motion is more or less impaired. This state may

or may not be conjoined with synovial disease within the articulation ; usually it is.

Treatment of Anchylosis.—In all cases, anchylosis should be most warily interfered with ; for it may be regarded as a compromise between health and disease—an imperfect cure, yet both a saving of the part and a cessation of morbid action—the rash infringement of which is most likely to be visited by untoward consequences. The true form is plainly not to be broken up, either by gentle or by violent means. The latter have been made trial of, with a result truly deplorable. A certain M. Louvrier invented an apparatus, by the rude force of which stiff joints were instantaneously straightened ; and patients were submitted to the torture of this “ infernal machine.” A few escaped with comparative impunity, yet with little improvement in the part ; in others, laceration, suppuration, gangrene, delirium were the results—“ accidents frightfully severe, and ordinarily followed by death.”* The only means of treatment to which anchylosis is amenable, is that formerly noticed, by section exterior to the obliterated joint and formation of a false joint thereby ; an operation which has been successfully applied to both the hip and knee joints, but in regard to the expediency of which we desiderate a larger experience.

Fortunately the true form of anchylosis is that which most rarely occurs ; a joint may seem to be rigidly immoveable, and that by ossification, yet may be altogether free from that form of structural change, and quite capable of a resumed, though it may be diminished, function—an example of either of the two other forms of the affection. Both of these admit of cure ; in many cases function may be wholly restored ; in others the restoration is never complete. In no case should it be attempted, till all active disease has wholly subsided within the joint ; and even then, the process of cure should invariably be warily and gradually conducted, lest re-accession of disease ensue. The means of restoration are :—passive motion, frequently employed with all gentleness, and always regulated by the sensations of the patient ; friction, with embrocations of a stimulant nature, especially over the extensor muscles ; local steam bath ; shampooing ; and, if need be, the division, by subcutaneous section, of the rigid flexor tendons. Splints, bandaging, and other mechanical means, are also often of service, in restoring normal position of the joint, not suddenly but slowly and with much caution ; and this aid is especially necessary in those cases, by no means few, in which there is not merely flexion of the joint to be undone, but rotation also. Thus, in the knee, as already stated, flexion is seldom great, without rotation outwards of the head of the tibia ; and unless this be rectified—as can only be done by mechanical means—the cure is obviously incomplete. When tenotomy has been employed, the restorative measures by friction, motion, and machinery, ought never to be had recourse to until the punctures have fairly healed—a few days usually suffice ; otherwise inflammation and suppuration might readily be induced.

The propriety may be here again urged of attention to the position of

* British and Foreign Medical Review. No. 24, p. 552.

the joint, in those cases in which the occurrence of complete and irremediable ankylosis is expected; in order that the rigid member may possess its maximum of usefulness.

Neuralgia of Joints.

Affections of joints, dependent on inflammatory action and the structural changes thereby induced, are the most frequent in occurrence. We are, however, not without examples of local irritation, in which perverted vascular action is almost wholly in abeyance. The prominent characteristic is pain, unaccompanied by swelling, or other indication of structural change. The affection may be either primary, constituting a disease per se; or it may be secondary, merely a symptom of an earlier and more grave disorder. In the knee, for example, we may have nervous pain, either as a symptom of morbus coxarius, or a truly neuralgic affection of that part, independent of disease elsewhere—although, indeed, the last observation must be made with some reservation, inasmuch as there are found but few cases of neuralgia, in that or any other joint, which are not more or less connected with a perverted state, as to structure, function, or both, in some of the internal organs.

Neuralgic affection of the joints is characterized by a class of symptoms sufficiently distinct; a circumstance of much importance, inasmuch as the appropriate treatment is very different from that which is demanded for structural change. The pain has the ordinary character of the nervous; remittent, intermittent, not slowly and steadily increasing, not constant, not increased by pressure, and not limited to one part, but diffused over the whole of a wide extent of surface. The patient's mind may be diverted from the uneasiness, by conversation, or otherwise engaging the attention; and while the mind is so occupied, the pain is really absent. There is no swelling; at least if there be, it is but trivial in all respects; a mere puffiness, by œdema of the surface; not at all resembling what follows inflammatory action in any of the textures of the joint. Motion is well borne; and so is manipulation, even rude; the uneasy sensations are not increased by either. The joint itself may be jarred, pressed, jerked with impunity; whereas much complaint may follow a pinching of the super-imposed integument; that texture sometimes seeming to be of greatly increased sensibility. There is no flexion of the joint, as in serious structural change; on the contrary, the limb will most frequently be found extended. The spasms too are wanting, which so frequently attend and invariably aggravate acute vascular disease. The patient is obviously out of health; and labours under irritation, general as well as local; but the system is uninvolved in either inflammatory or hectic fever.

This affection more frequently occurs in females than in males. And usually the symptoms will be found at least connected, if not caused, by disorder of an internal organ; hysteria; dyspepsia; irritation of the bowels, by worms, or by lodgement of other noxious matter. In children, some affections of the joints, apparently neuralgic, would seem to depend on the irritation of dentition.

The *treatment* of neuralgic joints is mainly directed towards the gene-

ral system ; restoring normal functions to the uterus, stomach, and intestines, as the circumstances of the case may require. The local applications need be but simple. The serious treatment for structural change would here be not only unnecessary, but certain to prove injurious. The endermoid use of nitrate silver, so as merely to blacken the surface, is on the whole the preferable application ; it not only is really efficient towards mitigation of the neuralgy, but also, having an imposing character in the eyes of the patient, is useful by satisfying the mental anxiety, which always attends, and sometimes is not the least prominent of the symptoms. Medicated friction or fomentation may also prove of service in a similar manner. But every stimulus, at all powerful, should be either abstained from, or most cautiously used ; inasmuch as the morbid condition of the nervous system of the part may here, as elsewhere, prove but a stepping-stone towards the accession of inflammatory action, entailing serious structural change.

The vital importance of a careful diagnosis need not be insisted on. Lest, on the one hand, we treat with unwarrantable severity a comparatively trifling disorder ; and, on the other hand, lest we commit the greater error, of supposing a really formidable change of structure in bone, cartilage, or synovial membrane, to be but a nervous affection, and discover not our error until loss of texture and function has become not only great but wholly irremediable.

Wounds of Joints.

Wounds penetrating into the more important joints, are invariably to be regarded as among the gravest of injuries ; and the danger is by inflammation of the synovial membrane. To either the aversion or mitigation of this, treatment is to be directed.

The signs of the accident are not indistinct. The nature of the weapon ; the manner and degree of force with which it was applied ; the extent, position, and form of the wound ; the trickling of synovia, in the form of oily globules, along with the immediate serous discharge which the wound affords ; the presence of a shock to the general nervous system, more or less intense—these, in the great majority of cases, are sufficiently plain indications of the joint having been opened into. It is wholly unnecessary to use either the probe or finger, in exploration. Meddlesome surgery is never good ; in no case is it more decidedly bad than here. Many a joint may, under suitable treatment, resist the original injury successfully ; but few are able to escape, with impunity, from wound followed by rude, unskilful, unnecessary exploration. The probe and finger are not used here ; the eye, aided by the lightest touch, is sufficient.

When the wound is of the lacerated or bruised kind, inflammation is inevitable. The track of the wound can heal only by granulation, which is invariably preceded by inflammation ; and inflammation of one part of the synovial membrane may scarcely be restrained from overspreading the whole. All that is in our power, under such circumstances, therefore, is to mitigate what we cannot avert ; to keep the action of a low grade, and save change of structure. When the wound

is simple and incised, however, the object of our treatment is altogether prophylactic. By absolute rest, rigid antiphlogistic regimen, and the continued application of cold, during the period of incubation; by loss of blood, general and local, timeous and plentiful, so soon as inflammation threatens to supervene; by calomel and opium, antimony, or other selection from the more powerful antiphlogistic remedies—we avert the true inflammatory crisis from both the interior of the joint and the wound's track, so obtaining for the latter union by adhesion. In favour of this result, disuse of suture is advisable; approximation being intrusted to plaster and position; and by that mode of dressing, also, another important indication may be fulfilled—exclusion of atmospheric influence. The wound, however, may be so extensive as to demand the aid of suture for its coaptation; in this case the stitches should be as few as possible, and especial care should be taken that they inclose skin alone; the deeper part of the wound's track, and more especially the synovial membrane, remaining untouched.

When inflammation with suppuration of the synovial membrane has occurred—as will sometimes be the case notwithstanding our best care—more or less structural change occurs in that texture; it becomes thickened, infiltrated, and coated by fibrinous exudation; at some parts it may be broken by ulceration. Ruin of cartilage and bone is not unlikely to follow. Such cases are to be treated on the principles, already inculcated, for similar diseased action of a non-traumatic origin. The symptoms are certain to prove most urgent. The inflammatory fever will be of the gravest kind; and, in addition to its ordinary signs, great irritability of the stomach is often both prominent and distressing; the swelling, pain, and discharge, will be proportionally great. Yet something like resolution may be effected; all may become quiet, and the joint may recover not only its form, but almost its pristine motion. Or it stiffens, by anchylosis, perhaps irremediably; change of structure having gone so far as to leave no hope of cure, unless by copious plastic exudation from the exposed bone. Or hectic becomes paramount, ere yet destruction of texture has ceased in the joint; and then, to save life, we must sacrifice the limb.

AFFECTIONS OF BURSÆ.

Bursæ are lined by a delicate membrane; very similar, both in health and in disease, to the synovial investiture of joints. They are of two kinds; the majority being of original and normal formation; a few, adventitious, the result of unwonted pressure, much or habitually applied. They may also be divided into those closely connected with the more important joints; being in truth accessory thereto; and into those which have no such relation, and are altogether insulated. The affections of the latter are comparatively trivial, as regards the ultimate result; acute inflammation of the former, on the contrary, is always to be regarded with suspicion, and treated with much anxiety and care.

Bursitis may be either acute or chronic. The *acute* is usually the result of external violence, of exposure to cold, or of both. The symptoms and results resemble those of synovitis. There is enlargement of the bursal cavity by distention; the secreted fluid being at first serous, then sero-purulent, and ultimately purulent, according to the progress of the inflammatory action. The tumour is distinctly fluctuating, and very painful to the touch. There is acute œdema of the super-imposed and surrounding cellular tissue; the skin is red and tender; and not unfrequently a smart erysipelas co-exists with the deeper inflammation. The lining membrane becomes successively congested, turgid, infiltrated, increased in vascularity, coated by fibrinous exudation; ultimately it ulcerates, the contents escaping towards the surface. The treatment consists, in the first instance, of the ordinary antiphlogistic means—as rest, leeches, fomentation, antimony—with a view to restrain the inflammatory process. If successful, the serous fluid soon disappears by absorption, as acute dropsy usually does, on subsidence of the action by which it was produced; if it linger, slight discutients will be sufficient to complete its dispersion. When, however, resolution has not been effected, and suppuration has occurred, we need have no hesitation in treating the case as an ordinary acute abscess, by free, early, and direct incision. Temporary aggravation of the inflammation may follow the infliction of the wound; it is met in the ordinary way; and, on its subsidence, healthy granulation will, under the suitable treatment, advance towards satisfactory cicatrization—the cavity being obliterated. When the bursa is in connexion with, or even merely in the vicinity of, an important articulation, our antiphlogistic efforts must be doubly energetic and anxious, to avert, if possible, involvement of the more important part. And when suppuration has occurred in such a bursa, incision should invariably be both early and free.

Chronic bursitis, a very common result of moderate and habitual pressure, gives a slowly increasing swelling, dull, and almost painless; without either superficial œdema, or redness of integument. The contents are usually thin and clear. The treatment consists chiefly in abstraction of the cause, taking care that the pressure be not reapplied; and in the employment of discutients; as blisters; mercurial plaster, or equal parts of the gum and mercurial; iodine, in form of ointment or of strong solution; gentle support by bandaging. Such means prove successful, when patiently and duly employed, in the great majority of cases. Should they fail, then the treatment may be as for hydrocele; drawing off the fluid by a trocar, and injecting a small quantity of the solution of iodine; acute œdema is produced; action soon subsiding, the serum is quickly absorbed; and, the balance of health having somehow been struck, re-accumulation does not occur.

Sometimes the cyst of the bursa becomes thick, indurated, and otherwise altered in structure. In such cases resolution is not complete; more or less hardness and swelling continue, in spite of the most active and persevering discutient treatment. Unless the symptoms prove unusually troublesome, however, severer remedies—as by excision—are scarcely warrantable. Sometimes not only is the cyst much

thickened, but the interior is also filled by a fibrinous deposit, partially organized. Such a state is not amenable to discussion; and may be safely treated as an ordinary tumour, by excision.

Sometimes the cyst slowly suppurates. The chronic abscess may perhaps be discussed; more probably it reaches the surface and is discharged. Even free incision may not be followed by satisfactory closure; an indolent purulent pouch remaining, filled only by ill-formed pus; and granulation proving sadly deficient. In such circumstances, the temporary application of a seton is advisable, to arouse the part to assumption of the required degree of sthenic action.

Small adventitious bursæ not unfrequently open by suppuration; and then remain open, continuing to discharge a thin fluid, partly bursal, partly purulent; through an irritable sinus, terminating in a more irritable ulcer—as in open bunion. The best mode of getting rid of such troublesome affections, is to insert a pointed piece of potassa fusa, and apply it freely to the whole of the secreting surface; a slough is formed, including the adventitious structure; and, on its separation, healthy granulation and closure will ordinarily follow.

Small adventitious bursæ may be chronically enlarged, and be themselves the seat of little pain or uneasiness; while from a red, glazed, and intensely irritable state of super-imposed skin, the patient may from time to time endure extreme suffering—as in the slighter form of bunion. In such cases, total abstraction of pressure, and the application of nitrate of silver, so as merely to blacken and desiccate, will suffice to restore all to a state of indolence and quietude.

Loose bodies are sometimes found in bursæ. If troublesome, they may be removed; by direct incision, if the bursa be insulated and small; by sub-integumental puncture, and secondary excision, when the bursa is large, or connected with a joint.

AFFECTIONS OF THECÆ.

The thecæ of tendons may be acutely affected by the inflammatory process, from rheumatism, or in consequence of external violence. More frequently the action is chronic; the slow, and perhaps remote, consequence of a blow or strain. A fluctuating swelling forms, with little pain; but with a marked feeling of uneasiness as well as of weakness in the part; the play of muscles, tendons, and sometimes of the neighbouring joint, being manifestly impeded. The treatment is by rest, pressure, and discutients. If the rheumatic diathesis be present, the ordinary remedies—as colchicum, iodide of potassium, &c.—are of course to be employed.

Loose bodies are much more frequently found in thecal than in bursal cavities. They are seldom single, and may be very numerous. Commonly they are of a uniform appearance and size, like barley-corns; of much softer consistence than the analogous formations in joints; most common at the wrist and shoulder, especially in the former situation; floating in a thick, glairy, but clear fluid; and causing much

inconvenience by swelling. On manipulation, during slight motion of the part, a characteristic crackling and grating are imparted to both touch and ear. Removal by direct incision will certainly be followed by intense inflammatory action; suppuration, with much constitutional disturbance, can hardly be avoided; and it is probable that on ultimate subsidence of the action, much change of structure will be found to remain, impairing the function of the part more seriously than did the previous swelling. Such loose substances, therefore, should not be interfered with, by operation, unless when especially troublesome; and then the subcutaneous and valvular method of incision should be invariably followed. Nor, when numerous, should an attempt be made to remove them all at once; otherwise atmospheric entrance is likely to take place, bringing on the dreaded inflammatory action; by repeated punctures, however, they may at different times be safely extruded. Should inflammation and suppuration unfortunately occur, we must unhesitatingly make a free and direct incision, braving the worst.

Ganglion.—This term is often applied to the diffuse chronic collections in thecæ; but perhaps it is more correctly limited to the distinct, circumscribed, and prominent, though small, collections, which so frequently occur at the wrist and ankle, particularly in the former situation. The cyst is thin and translucent; the contents are synovial; and the swelling, though tense, distinctly fluctuates. Sometimes no cause can be assigned; in other cases the origin is attributed to a strain. Females are more frequently affected than males. Mere deformity may be the result; or there may be weakness, with occasional pain, as well.

The indication of cure is very simple; to extrude the synovial contents from the interior of the cyst, to disperse them into the surrounding cellular tissue, and to promote their gradual removal thence by absorption. For this purpose it is necessary to effect an aperture in the cyst. If recent, pressure will be sufficient for this. The thumb or thumbs being applied energetically to the part, the cyst is felt to give way; the tumour collapses; by pressure and friction continued, the contents are completely expelled; and then a moderate pressure is maintained by compress and bandage, to prevent re-accumulation, while occasional smart friction is also used to favour absorption. If thumbs fail, the part may be struck by any hard substance; or, what is better, a fine needle, such as used for the eye may be introduced at one or more points to puncture, instead of rupturing the cyst; the instrument being cautiously withdrawn so as to prevent the entrance of air.

CHAPTER X.

DISEASES OF THE ARTERIES.

Arteritis.

THIS term denotes perverted vascular action in the arterial tissue ; as usual, whether or not such action be above or below the standard of true inflammation. It may be either acute or chronic.

I. ACUTE ARTERITIS.—The acute form of action may be limited to one portion of an artery ; or it may be of a spreading kind ; as in the venous tissue. 1. *The Spreading*.—This is of comparatively rare occurrence. The patient is usually beyond the middle age, and of a broken constitution. The disease is seldom limited to one vessel, but pervades a large portion, or even the whole of the arterial system of the part. The limbs, especially the lower, are the parts most frequently involved. The symptoms are obscure, and are apt to be mistaken for those of rheumatism. There is much constitutional disturbance, as can be readily understood, of a febrile kind ; but not showing the usual sthenic signs of the true inflammatory fever ; partaking more of the irritative type. The tracks of the main vessels affected are painful ; and pain is increased by pressure and motion ; induration, too, is felt ; the pulse is feeble, and has a peculiar thrilling feel ; its impulse gradually diminishes, and ultimately it wholly ceases, in the part. The super-imposed soft textures are seldom involved ; the skin remaining white, and otherwise normal in its appearance. The effects on the coats are turgescence and infiltration, with loss of the smooth serous character of the internal surface ; the contents become coagulated, and adherent to the changed tube ; ultimately the canal is wholly occluded. In proportion to the obstruction of circulation, which necessarily results from the progress of such change, the vital power of the parts affected is very much impaired ; both temperature and sensation are diminished ; and should stimulating measures be unwisely adopted to restore these, action beyond the power of control is almost certain to be induced, and gangrene follows. Indeed, if the obstruction be both complete and general in a part, its death will surely happen, as the direct result ; a simple cessation of vitality, without the intervention of the attempted inflammatory process. On the other hand, in the slighter cases, the original action may subside, ere yet consolidation has been complete ; the obstructing coagulum may be gradually removed, and circulation with vital power restored.

The treatment of such disorder, when detected, probably comes better within the department of the physician than of the surgeon. It will consist of leeching along the affected course, rest, antimony, and other ordinary antiphlogistics. A tolerably free administration of calomel

and opium may also be desirable, to prevent consolidation if possible. Opium, after depletion, will in all cases be suitable; not only as relieving pain, often severe, but likewise tending to maintain tone of the arterial system. Subsequently to the occurrence of obstruction, a mild mercurial course may be given, or other sorbefacients employed—while mercurial ointment may be applied over the affected trunks—with a view to gradual removal of the obstructing coagulum. But all stimulating applications, whether external or internal, more especially the former, must be used with the greatest possible caution, lest the untoward result of action exceeding power be induced. When obstruction has become confirmed, the principal care had better be directed to the avoidance of all stimuli, whereby such excessive action might be occasioned.

There is good reason to believe that an especially acute and spreading form of arteritis sometimes, though very rarely occurs; analogous in its character to the worst kind of phlebitis. It commences in a part, but tends to involve the whole system. The true inflammatory crisis is reached, ere coagulation has occurred; purulent matter, consequently, when effused from the internal coat, mingles with the circulating stream; and, carried throughout the system, has the same poisonous effect as in diffuse suppurative phlebitis. First, irritative fever attends on this form of disorder; but, on the occurrence of the direct purulent admixture, this is merged wholly in typhoid symptoms of the most urgent kind, under which the patient rapidly sinks. Should he struggle on for some time, gangrene ensues; and probably occurs at more points than one. In such a disease, it is plain that hope from treatment can only be entertained at the outset. This period, therefore, should be occupied in the use of our most active and powerful antiphlogistics. On the suppurative crisis having been reached, the lowering treatment must pass into that of support; but with scarcely a hope of successful issue.

2. *Limited Arteritis.*—This is a very common result of external injury done to the tissue; as by wound, or by application of ligature. Various results may ensue, corresponding to the amount of action induced. The minor grades will give exudation of a plastic kind, such as we desiderate after deligation; the coats become turgid and coherent; and the canal is compactly obliterated, at the part affected. A higher grade of action, reaching to the truly inflammatory, gives supuration, usually conjoined with ulceration; a result which we do not desiderate, but on the contrary take every means to avoid, in operations on the larger vessels; hemorrhage being almost certain to follow. A still higher action, more especially if conjoined with circumstances tending to impair vital power in the tissue, causes gangrene of the vessel; a still more disastrous event; exemplified by the result of deligation of an artery, whose coats have been too rudely manipulated, and too extensively separated from their cellular connexions.

The treatment of this form of arteritis consists in the employment of ordinary mild antiphlogistics, chiefly local; and so conducting our direct interference with the vessel, that the minor grade of action only shall be obtained, whose characteristic is plastic exudation, with obliteration of the canal at the affected point.

II. CHRONIC ARTERITIS, is of infinitely more frequent occurrence than the acute ; and usually is idiopathic. It seldom occurs till after the middle period of life ; is more frequent in males than females ; and its accession would seem to be much favoured by a shattered state of constitution, more especially from intemperance, and abuse of mercury. It is frequently associated with hypertrophy of the left ventricle of the heart.

The acute arteritis may be said to be chiefly connected with injury of the arterial tissue ; the chronic, with its disease. The latter is often associated with the rheumatic diathesis, which seems to cause a strong predisposition to arterial change.

Chronic arteritis is extremely gradual and insidious in its progress ; scarcely marked by pathognomonic symptoms ; and seldom discovered, during life, but by its results—anormal dilatation of the artery, and formation of true aneurism. The structural change, however, is sufficiently marked. It may affect an artery throughout its whole extent, continuously ; or occur only in patches ; and such patches are usually situate in the vicinity of bifurcations, or at the origins of large arterial branches. The internal coat is thickened, spongy, and less smooth and serous in its surface. Between this and the middle coat—in the intermediate tissue which is sometimes termed the sclerous coat—deposit takes place of a soft caseous-looking substance, in granules or patches ; sometimes termed atheromatous, sometimes *steatomatous* ; but, according to the recent researches of Mr. Gulliver, the latter is the more correct appellation, inasmuch as its chemical constitution seems to differ but little from that of ordinary fat. Not unfrequently the middle coat too is altered, becoming thin, yellow, and opaque. In consequence of such change, the arterial tissue is found to have its elasticity much impaired ; it will not accommodate itself to the play of extreme motion, as before. Its cohesion is diminished ; if forcibly stretched, it is apt to tear, especially in its inner coat. It is incapable—comparatively, sometimes actually—of plastic exudation ; if a tear do take place, it is not likely soon to close again. On the contrary, it is more likely to widen by ulceration ; for, proneness to that morbid result is another consequence of the structural change. Hence it will at once appear, how an artery so circumstanced is but little amenable to deligation ; occlusion will not take place by fibrinous exudation of a suitable kind ; by ulceration the unobstructed canal will be opened into ; and dangerous hemorrhage necessarily ensues. It is also equally plain how the occurrence of aneurism is favoured ; by the proness to ulceration ; and by the impairment of elasticity, cohesion, and plastic power. Dilatation, rupture of the internal coat, non-repair of the breach, on the contrary its extension, are obviously rendered liable and likely.

The *calcareous degeneration* is very different from the state just described. It is the concomitant and result of old age, irrespective of the arteritic state. As the arcus senilis forms on the cornea, as the body bends, as the prostate enlarges, as the teeth drop out, and the cartilages ossify, so the arterial tubes are liable to become hard and non-elastic, by deposit of earthy matter between the internal and middle coats, sometimes in granules, more frequently in scaly patches, some-

times in continuous masses. The internal coat is dry and shrivelled in appearance; sometimes loose and almost villous in its surface; sometimes torn, shrivelled, and raggedly projecting; not unfrequently the calcareous scales have extended into its structure. Very often the steatomatous deposit may be seen mingled in greater or less proportion with the calcareous, in the artery of the old man. And sometimes a few calcareous scales may be found among the steatomatous deposit, in the artery of the man of middle age. The calcareous deposit is ordinarily termed ossification; but the hard substance is altogether different from bone; devoid of stroma, of fibrous arrangement, and of vascularity. Sometimes it is so extensive as almost to banish all trace of the original structure of the vessel, converting it into a rigid earthy tube.

This state, also, must obviously interfere with the elasticity and plastic power of the tissue. Yet aneurism much more seldom follows upon this than on the steatomatous change. It is probable that cohesion is less impaired, and ulceration less liable; also it is plain, that, in consequence of this earthy change occurring only in advanced age, when muscular effort is much less sudden and extreme than in younger years, one of the most common exciting causes of aneurism is not likely to be in operation. The calcareous degeneration seldom occurs, to any extent, before sixty years of age. But the period of proneness to aneurism is found to range between the ages of thirty and fifty—the period of muscular exertion, exposure to hard living, and liability to the steatomatous degeneration of the arterial coats.

Both forms of degeneration may be said to be limited to the aortic system. The pulmonary is almost wholly exempt.

For the calcareous degeneration we can do nothing. When the steatomatous is suspected, all stimuli should be abstracted, the diet carefully and temperately regulated, sudden and great muscular exertion avoided, as well as mental excitement or other causes likely to occasion acceleration of the sanguineous flow. If the rheumatic diathesis be present, or the system have suffered by syphilis or by mercury, means must be taken to counteract the cachexy. If need be, the force and rapidity of circulation may be further controlled, by digitalis, aconite, or other sedatives on the heart's action.

Aneurism.

By this term is meant a pulsating tumour; composed of a cyst, which is filled with blood, partly fluid, partly coagulated, and whose cavity communicates with the arterial canal.

Various divisions have been made of this important subject. The most ordinary, as well as most useful, is into the *true* and *false*. And to these terms it is essential that definite meanings be attached. Various interpretations are given by different authors. But here let it be understood, that by true aneurisms we mean those which are the result of disease; the tumour being formed by dilatation, or by either rupture of the coats or their ulceration from within, or by a combination of both circumstances; and the cyst consisting of one or more of the arterial coats, yet undivided. The term *false*, on the contrary, denotes those

aneurisms, in which the arterial tunics have been wholly divided, either by wound or by ulceration from without, and form no part of the aneurismal cyst. These constitute the minority, the former the majority, of the cases of aneurism.

I. *TRUE ANEURISM*.—This may vary in its mode of formation. 1. *By Dilatation*.—This is most frequent in the aorta. The coats do not give way, either by rupture or by ulceration, but evenly dilate into a pouch of greater or less volume; in the parietes of which the steatomatous deposit is apparent, and the continuity and integrity of the tunics can be distinctly traced—more especially after maceration. The dilatation may be partial, on one aspect of the canal; the hollow swelling which results is said to be Sacciform. Or the whole tube gradually dilates, and gradually recovers, giving rise to a spindle-shaped enlargement, which is termed Fusiform. Or the general dilatation may be abrupt and in all respects uniform; it is then said to be Cylindroid.

2. *By Dilatation and Rupture*.—In this form, commencement of the tumour and anormal cavity is made by dilatation of all the coats. Then the internal gives way, either by ulceration, or by tearing during some sudden muscular exertion; the middle coat usually yields at the same time; blood in consequence becomes insinuated into the aperture; the external coat yields before the pressure from within, and, expanding, forms the true aneurismal cyst. This new cavity is filled by fluid blood; and, under the impulse thence received, it gradually enlarges the cyst; receiving strength and addition both from without and from within; from within, by deposit of fibrin from the blood; from without, by condensation and incorporation of the surrounding cellular or other soft tissues. By condensation and organization of part of the fibrin from within, and deposit from the living texture as well, the interior of the cyst may come to be lined with a quasi-membranous structure; analogous to, and often apparently continuous with the internal coat of the artery. This, however, will only be apparent at those points where there is no agglutination of the fibrinous clot, and where no recent fibrinous deposit has taken place. Resistance to enlargement of the tumour is made partly by the strengthening of the cyst, partly by the contractile effort of repression afforded by the surrounding tissues. The first part of the process of formation is gradual and slow; on the giving way of the coats, the increase is sudden and considerable, and for a time rapid; often the patient has, by sensation in the part, a distinct perception of the event. This is the most frequent form of aneurism.

3. *By Rupture*.—This kind of tumour forms rapidly from the first; and may in but a short time attain a large size. The immediate or exciting cause is sudden muscular exertion, as in pulling, leaping, &c., whereby the arterial tunics are stretched beyond what they are able to bear. The internal and middle coats give way at once, by laceration, and the aneurismal formation speedily follows. The patient has generally a very distinct perception of the tear, and consequently of the very first origin of the tumour. Sometimes the event occurs, during the ordinary exertion of walking; then he is apt to suppose that he has been struck on the part by a stick or stone. But this exciting cause is

not alone sufficient; there must be a predisposing one also; and that is the steatomatous degeneration. Were it not for this, the tear might simply heal; or, at all events, fibrinous exudation would take place of a plastic kind, and thereby the arterial tube would be obliterated; there would be no aneurism. But when the degeneration exists, no such plasma is afforded, no such reparative effort can be made; on the contrary, the tear widens by ulceration, and the aneurismal formation advances.

Varieties.—1. *Dissecting.*—An aneurism is said to be dissecting, when the arterial tunics are more or less separated from each other by the blood's infiltration. The external coat alone may be detached from the middle and internal. Or the middle may seem to be split; the true elastic going with the cellular coat; the truly fibrous with the internal.* Also, the dissection may be either complete or partial. That is, the hiatus between the coats may terminate in a blind sac, where the blood stagnates, or whence rather it will regurgitate. Or it may be complete, there being a second aperture of communication with the artery, at the extremity of the hiatus, through which the collateral current of the blood again finds the main stream. The dissection may be of slight extent, or it may occupy several inches of the vessel. The variety is of comparatively rare occurrence; and is seldom found affecting any artery except the aorta. 2. The inner coat alone may remain entire; the external and middle have given way; the cyst is formed, in the first instance, by the dilated internal coat alone. In true aneurism, this condition is rare; it has been observed by Breschet, Dubois, Dupuytren, and others; probably the result of ulcerative destruction of the other tunics, from without. 3. The inner and external coats have both been found entire; the middle alone having given way. 4. It is useful to remember that an aneurism is sometimes connected with the artery by means of a narrow neck of considerable extent, instead of the anormal cavity being bluffly set upon the anormal tube. The fundus of the pulsating tumour may consequently project several inches from its arterial origin; and, in certain situations, as at the root of the neck, diagnosis is thence rendered obscure. An aneurism may seem to be of the innominata, or of the first third of the subclavian, while in truth it is of the aorta. Such a tumour is said to be *Pedunculated*.

Aneurism is also said to be *limited* or *diffuse*, according as it is bound within the limits of a proper cyst; or, having either burst through this, or been originally devoid of it, the blood is widely diffused by infiltration into the surrounding tissues.

The true aneurism is at first invariably limited. It may become diffuse by giving way of the cyst, from ulceration or otherwise. The occurrence is always secondary. In false aneurism, on the contrary, the form may be diffuse or not at first, according to circumstances. If the escape of blood be sudden, great, and violent, no distinct restraining cyst can form, infiltration is wide and free; the diffuse form is at

* For most practical purposes, it is enough to regard the arterial tissue as consisting of three layers—internal or serous, middle or fibrous, and external or cellular. But microscopically, the number of layers may be doubled—1. The epithelial. 2. The true serous. 3. The sclerous. 4. The truly fibrous, or circular. 5. The truly elastic. 6. The cellular.

once established. Or the cyst may have formed, and subsequently given way; and then, as in the true form, the occurrence is secondary. As will be seen, supervention of the diffuse form is sometimes salutary; more frequently pernicious.

II. FALSE ANEURISM.—In this form, as already stated, the aneurismal cyst is not composed of any of the arterial coats, but entirely constructed from the tissues exterior and adjoining to the vessel. 1. Most frequently, it is the result of wound; all the coats being at once perforated; the blood escaping in considerable volume and force; and thereby condensing for itself a cyst, which subsequently becomes strengthened, yet dilates, in the ordinary way. 2. Or it may be the result of laceration; as in severe fracture of a limb. The main artery is torn, either partially or completely. Profuse hemorrhage is the result, infiltrating the neighbouring soft parts, or perhaps distending them to form a large bloody pool; the arterial aperture does not heal by fibrinous occlusion, but, remaining patent, establishes a permanent communication. The diffuse form of aneurism is thus at once produced. Or the occurrence may be secondary; at first, the artery is only bruised; it sloughs, or ulcerates; and then, pouring out its blood—it may be several days subsequently to the injury—the aneurism is established. 3. Or the arterial coats may be perforated by ulceration from without. An abscess forms in the immediate vicinity of an arterial trunk. Evacuation is delayed; and the spontaneous approach to the surface is repressed by fibrous investments. The cavity of the abscess enlarges deeply, and compresses the arterial tissue. This at first is protected by fibrinous exudation, which seems as if specially provided. By and bye the arterial tube may come to traverse the cavity of the abscess, extension having occurred on its every side. Pressure is great and constant; the arterial connexions are weakened or altogether removed, by the dissecting action of the pent up pus; and under the combined action of the constant and steady pressure, with diminished power of control, ulceration is ultimately established. The arterial canal becomes continuous with the cavity of the abscess, through an ulcerated aperture, perhaps of no great size. The cavity, formerly filled with pus, becomes occupied by blood; what was an abscess, has become a variety of false aneurism. One obvious advantage of the narrow aperture of communication is, that the pus is gradually, and not at once, brought into the general circulation—for a time continuing to whirl in turbulent motion within its own cyst; and thus the system will probably be saved from those formidable typhoid symptoms, which usually follow any considerable and direct admixture of pus with the circulating mass of blood. A memorable example of this form of the disease was lately afforded by the hospital experience of Mr. Liston.*

The most common example of false aneurism, is that which follows accidental wound in venesection at the bend of the arm. The mistake is usually at once discovered, and means taken to avert the consequences; by energetic and direct pressure on the part. Blood in con-

* British and Foreign Medical Review. No. 29, p. 155.

sequence escapes but slowly from the wound of the artery. By the pressure, it is prevented from being discharged externally. It slowly accumulates in the cellular tissue, exterior to the artery, and beneath the fascia of the fore-arm. The cellular tissue becomes condensed into the form of a cyst, which, as in the true aneurism, receives corroborating addition both by deposit from the blood, and by amalgamation of other tissues on its exterior. The internal additions come to assume a regular form, where incorporated with the original cyst; they become fully organized, and, acquiring a compact structure, constitute a lining membrane to the cyst, smooth, and somewhat of a serous character; often seeming to be continuous with, and not very dissimilar to, the internal coat of the artery. The cyst may ultimately give way, and the aneurism become diffuse; but this is by no means probable, seeing that the cyst is powerfully strengthened by the investing fascia of the fore-arm. Or, when the remedial pressure is either absent or imperfect, the bloody swelling may be large and diffuse from the first. The coagulum is seldom dense throughout, in either the diffuse or circumscribed variety; but often has a central space or canal, continuous with the arterial aperture. In recent cases, treated by incision, this circumstance may be of some practical interest; facilitating the exposure of the bleeding point.

By some it is supposed that the aneurismal formation is different from that just described. That the escape of blood, and formation of an exterior cyst, are not immediate; but that the aperture in the vessel is first filled up by a membranous formation; and that this, yielding before the blood's impulse from within, gradually dilates and forms the aneurismal cyst. I am far from saying that false aneurism may not in this way be produced. But I believe that such a mode of formation is comparatively rare, and forms the exception rather than the rule.

However formed, the false aneurism has one very important practical point in its nature; namely, its formation being independent of arterial degeneration. In consequence, we have it in our power to apply our remedial ligature in the immediate vicinity of the tumour; naturally expecting to find the arterial tunics as sound there as at any other point.

Symptoms of True Circumscribed Aneurism.

This being by much the most frequent form of aneurism, the symptoms of it may be regarded as descriptive of the disease in general. We are also to be understood as referring to the aneurisms which are external to the great cavities of the body, and consequently amenable to surgical treatment. There is a swelling, at first small, and gradually increasing; originally soft and quite compressible, the cyst being as yet filled only with fluid blood; ultimately hard, and incapable of being made altogether to recede, its interior having become occupied by a greater or less amount of solid coagulum. But however great the diminution, or even complete the disappearance, may have been under pressure—so soon as this is removed, there is an immediate and forcible return to the former dimensions. In the tumour there is distinct pulsation, from the beginning; appreciable by both sight and touch, but

more especially by the latter; synchronous with the heart's impulse; equally felt in all aspects of the tumour; increased by pressure on the distal side of the tumour; diminished, or perhaps wholly arrested, by pressure on the cardiac. At each impulse, there is not only an elevation of the tumour, but a distinct expansion of it at every point. The more firm the pressure applied, the more distinct the impulse, and the more evident the simultaneous effort of enlargement. At the same time, a very expressive thrill is imparted to the compressing hand; and if the ear be applied, mediately or immediately, a *bruit de soufflet* will be heard, more or less distinct. The bruit, however, it is important to remember, is not an infallible indication of the presence of aneurism. Pressure on the artery, by the stethoscope, or by any tumour, may induce it; and it is also found when no structural change at all exists, seeming to depend on an impoverished and deficient state of the blood. The growth of the tumour is steady; seldom so rapid as the outward bulging of an abscess; seldom so tardy as the enlargement of any solid tumour, not malignant. Pain is complained of, not so much on account of the structural changes in the artery itself, as in consequence of the subsequent interference with the adjoining textures, as the enlarging tumour encroaches on them. By pressure on the passing nerves, pain is not only occasioned, but a numbness also of the lower part of the limb. By pressure on the veins and lymphatics, passive congestion is induced, causing more or less œdema, by which the limb is swollen and discoloured. From the same cause there is physical weakness, diminution of temperature, and impairment of function. And let it never be forgotten, that vital power—the power of resisting or controlling vascular excitement, and averting its untoward results—is very much impaired. Important organs in the neighbourhood may have their functions seriously impeded by the bulging of the aneurism; compression of the air passages, may threaten asphyxia; inanition may be impending, by obstruction of the gullet. The patient's own perception of the disease is usually very distinct. He sees and feels the living, beating tumour. But the period at which he first becomes aware of its presence is very various. If it have been formed by dilatation only, weeks or months may have elapsed, subsequently to its origin, ere it arrests his attention. If it have been produced by the second mode of formation, the first stage, by dilatation, may have passed unnoticed, but the aggravation by giving way of the coats is usually very distinct. And, as already stated, when the disease has begun by sudden laceration of the tissue, the very instant of origin is noted and remembered by the patient.

As the tumour enlarges, the artery contracts on its distal aspect, and circulation is weaker there. Did the lower limb depend for its arterial supply wholly on the contents of the affected trunk, vital power would be brought much lower than it is. But the diminished volume of the main stream is compensated, by enlargement of the side channels. What is termed the collateral circulation—at all times existing—is amplified to atone for the deficiency. Collateral branches, arising above the tumour, enlarge; and, passing round the aneurism, pour their increased contents again into the main trunk. Some inches beyond the

tumour, the arterial canal again shows its normal dimensions; the circulation is ultimately the same; only, at and around the tumour, it is partly direct and partly circuitous.

The tumour has not existed for any very long time, before the contents begin to assume, in part, the solid form. Fibrin is separated, and becomes arranged in concentric laminæ. Part is incorporated with the inner surface of the cyst; strengthening it, as before stated; it loses its colouring matter, and becomes connected with the cyst by both organic arrangement and vascularization. The greater bulk of the fibrin is not incorporated with the living texture; if it be adherent, it is only partially; most frequently it is loose in the cavity; arranged in laminæ distinctly concentric, with the interior greatly deprived of its colouring matter. In consequence of this accumulation of solid fibrin, the pulsation and compressibility of the tumour are affected; the former may be somewhat less distinct at certain points than at others, according to the form and adhesion of the clot; and if the clot be both dense and large, while the aperture of communication between the cyst and artery is small, very little diminution of bulk may be effected even by energetic pressure. This state of matters, however, is no disadvantage; on the contrary, it is by such change that spontaneous cure is accomplished. The clot, enlarging, comes to occupy the whole cavity; and then becomes at all points adherent, and incorporated with the cyst. The cavity is obliterated, the tumour consolidated. There is no room for the entrance of fresh and fluid blood; it either passes on in its own proper channel, as in health; or, as more frequently happens, the solid tumour re-acts on the arterial canal, bulging into it, obstructing its flow, and inducing its ultimate obliteration at that point. There being no longer an impulse from within, the restraining influence from the contractile effort of the adjoining tissues is now unopposed; and thereby the gradual subsidence of the tumour, by absorption of the solid contents, is greatly favoured. Ultimately, by continuance of absorption, and absence of increase—whether by simple deposit, or by secretion—almost all trace of the tumour has disappeared; the artery is usually found occluded at the site; sometimes, but rarely, its canal remains still pervious. The occurrence of such a chain of events is, however, unfortunately rare. In the great majority of cases, unaided by our art, the coagulum does not solidify the tumour, but merely acts as a restraint upon its growth; interposing itself between the cyst and the arterial impulse, and thereby moderating the former's expansion.

As the tumour enlarges, the adjacent parts, more especially those in the direct form of the principal increase, are displaced; and, as we have already seen, they may have important functions disturbed thereby. But there is not only mere displacement and interruption of function; change of structure is induced. Part of the super-imposed textures becomes incorporated with the cyst; part is removed by absorption; sometimes true ulceration occurs. Fibrous texture resists long; and may determine the increase in a lateral direction; also, by its unaccommodating opposition to the impulse beneath, much local pain, followed by constitutional disturbance, may result. Bone is less resisting; it cannot yield like the soft textures by elasticity; but it loses substance

at the point compressed, by continuous absorption; and, if the pressure be great, ulceration may supervene; ultimately, there may even be degeneration into caries. Most frequently, however, the osseous destruction is only by absorption. Between the bone so affected, and the contents of the aneurism, there may be interposed the ordinary cyst, more or less attenuated by the pressure. Or that portion of the cyst may have been wholly removed, and its place occupied by the bone itself; the wave of blood washing the bare cancellated tissue, without even a coagulum interposed.

As thus the tumour enlarges, in spite of the resistance from superimposed parts—the impulse from within proving paramount—the symptoms are not merely local; there are pain, numbness, œdema, and more or less disturbance of function, according to the nature of the parts compressed, and the degree of their compression; but besides, the system is sooner or later involved in obvious irritation. The stomach and digestion fail, sleep is disturbed, strength and flesh decline, the pulse becomes weak and frequent; in fact, the ordinary symptoms of constitutional irritation are established; more or less urgent, in proportion to the resistance which is afforded, and the importance of the parts to which the pressure is applied.

At length the crisis is approached: the tumour having reached the integumental surface, or the border of a mucous canal or of a serous cavity. The last intervening texture gives way; and then the fatal result is seldom long delayed. The opening is effected in different ways. 1. On the surface, the same occurs as with abscess; a portion of the skin is attenuated, sloughs, and separates. 2. In a mucous canal, the aperture is made by continued destruction of tissue at the part most compressed, either by absorption or by ulceration; most frequently, it is probable, by the latter. Or, it may happen that the progress of ulceration in the mucous membrane may be reversed. For example, an aneurismal tumour may compress the lower part of the trachea, threatening asphyxia; tracheotomy is performed, and a long elastic tube is worn in the wound; the extremity of that tube presses upon the apex of the aneurism; and by that pressure, ulceration of the mucous membrane is induced; the ulceration continues, advancing towards the aneurism, and so the latter's cavity may be exposed. 3. A serous cavity is opened, by attenuation of the serous membrane, from absorption under the continued pressure; and then laceration takes place at the attenuated part.

When, at any stage of its progress, the aneurism becomes diffuse, the symptoms are materially altered. The pulsation is diminished, in consequence of the pressure which is exercised on the arterial tube, by the blood infiltrated around; and it may happen—all untoward circumstances remaining aloof—that thus the probability of spontaneous cure may be enhanced; indeed, in some cases, we have no hesitation in attributing the origin of a spontaneous cure to the occurrence of the diffused form. But it is more likely that the issue will acquire an untoward tendency by this event; the limb is endangered, and secondarily the system. The interruption to the arterial flow, by the rapid and profuse infiltration of blood into the general cellular tissue, may be so

great, as at once to occasion gangrene of the limb, with its pernicious reaction on the system. Or, the arterial influx may be but partially interrupted; enough passing barely to maintain vitality; but insufficient for maintenance of due vital power. By and bye, inflammation with unhealthy suppuration is not unlikely to occur in the infiltrated and broken up textures; and such an amount of action is certain not to cease at the merely suppurative result, but, power of control being so much abased, it advances to gangrene, involving not merely the part, but the whole limb—all the more likely, if local stimuli have been imprudently employed. Early amputation then affords the only prospect of preserving life. When part of the infiltration is superficial, discolouration of integument necessarily attends: let not this be mistaken for the indication of gangrene already established.

The *fatal issue* of aneurism may occur in various ways. 1. By hemorrhage. The intervening textures have all given way, as formerly detailed. A gush of blood follows the establishment of the open condition. But this is seldom, if ever, at once fatal, as might have been expected, even in the largest and most active tumours. For, a portion of the coagulum, becoming impacted in the orifice, for a time stems the flow. By and bye this plug may be extruded or dislodged, and the hemorrhage returns; again it may be arrested, and again return; and thus by a repetition of bleedings, the patient is ultimately exhausted, and perishes. 2. By pressure on important parts, as on the trachea, œsophagus, nerves, &c. Aneurisms of the arch of the aorta, for example, usually prove fatal by the injurious effect on respiration. 3. By mere constitutional irritation; the system sympathizing with the local disorder. And, *cæteris paribus*, the greater the obstacles to the tumour's enlargement, the greater the amount of constitutional disturbance. Fibrous coverings delay the onward progress of the aneurism to the open state; but do not avert, though they may delay the fatal issue; ere hemorrhage has had an opportunity to occur, the patient may have been carried off by the wearing hectic. 4. By inflammation and suppuration of the sac. The secretion of pus may prove great and protracted, and even amputation may fail to arrest the exhaustion therefrom. 5. By diffusion of the aneurism, inducing gangrene of the limb, in the manner formerly explained. Typhoid symptoms may at once set in with force, and forbid the doubtful chance of amputation.

The *Diagnosis* of aneurism is one of the most important points in practical surgery. The following considerations will ordinarily enable us to escape from error. Chronic abscess, and glandular or other solid tumours, are the morbid states most apt to assume the aneurismal characters: often they, especially the latter, simulate the disease very closely; strong and distinct pulsation being communicated by a neighbouring artery of large size. But—1. Aneurism is soft and compressible from the first, and then becomes hard by solidification of its contents. An abscess may be soft from the first, but more frequently begins with induration, and softens secondarily; reversing the progress of aneurism. A small, chronic, and scrofulous abscess may be soft from the first; and may perhaps seem to be compressible; situate, for example, on the groin, in the axilla, or at the root of the neck, it may

seem to disappear by pressure, beneath the surrounding hardness; but, on removal of the pressure, the lively resilience of the aneurism is wanting. An enlarged gland, or other tumour, is invariably first hard, then soft, and never capable of being dispersed by pressure; and, unless suppuration occur, the softening and fluctuation do not supervene at all. 2. Pulsation is equable in aneurism. At every point unless much alteration by partial consolidation have occurred, the pulsation is felt equally distinct; whether the tumour is compressed directly downwards, or elevated and compressed laterally, the pulsation is the same. A solid or other swelling, not aneurismal, laid over the track of an artery, and receiving impulse from it, has a very distinct pulsation when the first mode of pressure is employed; but when raised, and held by the sides, this pulsation will be found either very faint, or altogether absent. 3. Pulsation of aneurism is felt from the first. Not so, in the case of swellings not aneurismal. At first they are small; and, not encroaching on the vessel, they receive from it no impulse. Only after some time, do they enlarge to such an extent as to be in close contact with the artery, and receive its pulsation. 4. Aneurism has expansion co-incident with pulsation. The fingers placed firmly on the tumour diminish it more or less; the pulsation is felt increasing in proportion to the pressure employed; and at each impulse there is a palpable elevation of the hand, by expansion of the walls of the cyst. A swelling not aneurismal, on the contrary, may be elevated at each stroke of the vessel, as well as have its apparent impulse augmented by increase of pressure; but it never can have expansion of its entire bulk, at every point; it is simply raised—and, whether in systole or diastole, its dimensions are unaltered. 5. An aneurism ordinarily affords both thrill and bruit to touch and auscultation. Another tumour may possess the latter, but has not both conjoined. 6. Pressure on the cardiac aspect of the aneurism, diminishes its pulsation, bulk, and thrill; pressure on the distal aspect, has a precisely contrary effect. Another tumour may have its apparent pulsation similarly affected; but the pulsation only. 7. Change of relative position affects the aneurism but little. Pull it rudely aside, and, by impeding the arterial flow, the pulsation, expansion, and bruit may be diminished; but, though diminished, they are still there. Do the same to another tumour, and pulsation is gone quite. 8. Perhaps the tissues are lax enough to permit of the vessel's course being traced by the fingers. If the tumour be aneurismal, it will be impossible to detach it from the artery; if non-aneurismal, the vessel will be found at all points perfectly free; at the supposed neck of the aneurism, perhaps, the finger's point may be inserted between the tumour and arterial tube.

Causes of aneurism. The disease is rare in the lower animals; more frequent in men than women; and seldom occurs before the period of puberty. 1. *Predisposing causes.* For the formation of true aneurism, as has already been stated, the existence of the steatomatous degeneration of the arterial coats is essential. The most frequent site of such degeneration, and consequently of aneurism, is at the turnings of the blood's current; whether by the natural curves of the vessel, as at the arch of the aorta; or by the giving off of large branches, collaterally, or

in bifurcation. The period of life most favourable for the morbid change, is between the ages of thirty and fifty. By the degeneration, the elasticity and tone of the vessel are greatly impaired at the part changed; and the defect is usually proportioned to the extent of structural change. At each impulse from the heart, the coats yield before the wave of blood, but, wanting resilience, fail to recover themselves as before; and thus dilatation is established and increased; the dilatation in form and extent probably proportioned to the extent of arterial degeneration. The dilatation may proceed; itself forming an aneurism. Or the internal and middle coats give way; and then the aneurism more rapidly advances, in the manner already detailed. When the aneurism has been formed by dilatation only, the communication between the cyst and artery is of course wide and free; often of the same extent as the cyst itself. When it has resulted from giving way of the coats, the aperture is of more limited dimensions, usually of circular form, sometimes no larger than a quill; with margins well defined, smooth, and often of great density.

The senile earthy degeneration may also induce aneurism; but does so much less frequently than the steatomatous. The change, it is probable occurs in the following way. Where the earthy deposit is greatest, a greater or less narrowing of the arterial canal is occasioned. On the cardiac aspect of this constriction, dilatation occurs. This may itself prove aneurismal. Or, as is more likely, the coats at this part yield either by laceration or by ulceration; and then the aneurismal formation proceeds in the ordinary way.

2. *Exciting causes.* The more prominent of these are violent muscular exertion, and mental emotion; either of which, but more especially the former, may directly cause the giving way of the coats.

Certain occupations favour the disease. Those persons, for example, who are exposed to intemperance by their vocation, as well as compelled to undergo heavy labour which often demands sudden and great exertion, are daily under the operation of both predisposing and exciting causes. And, again, if the elderly and not too temperate patient be by his calling exposed to sudden stretching of a vessel, after prolonged relaxation of it—without hard labour, or great muscular effort, occasional or habitual—aneurismal formation is likely to occur. For example, the postilion, or any one similarly circumstanced, who has for hours his popliteal artery much relaxed, in the bent position of the limb, may by sudden stretching of the member, on resumption of the erect posture, cause partial rupture of the coats; and if arterial degeneration be present, as is not unlikely, aneurism certainly supervenes.

In some cases, the steatomatous degeneration pervades the whole arterial system; and the tendency to aneurismal formation is in consequence universal. Patients so affected are said to labour under the *aneurismal diathesis*; prone not only to aneurism, but to aneurisms; the tumours, in such cases, seldom proving single but gregarious. The existence of such a state is indicated by a peculiar thrilling jar of the pulse, as well as a wiry hardness of the vessels, and an obvious cachectic state of the patient. It contra-indicates surgical interference with any aneurism, however favourably adapted it might otherwise seem for operation.

Cure.

Towards this end, as already stated, there occur, coagulation of the aneurismal contents; re-action of the super-imposed and surrounding parts on the solidified tumour; compression, thereby, of both tumour and artery; probably obstruction of the latter by extension of the coagulum. The fibrin loses its colouring matter, and in part becomes organized—where in contact with the cyst; absorption of the solidified tumour gradually advances; ultimately all traces of the aneurism have almost or wholly disappeared; and the artery is either permanently obstructed, and obliterated, at that point; or—as rarely happens—it remains free and pervious.

The cure may be either spontaneous or surgical.

I. *The Spontaneous.*—The changes formerly described, as effecting the spontaneous cure, may be induced by various circumstances. 1. By pressure on the cardiac side of the tumour. The artery may be here compressed by the aneurism itself, it having enlarged chiefly in that direction, and being bound on the vessel by fibrous investments. The arterial flow to and into the cyst is consequently moderated, and the occurrence of solidification favoured. Or similar pressure, with similar effects, may be exerted, not by the original tumour, but by the formation of another aneurism in the cardiac proximity; the cure of one disease, by the establishment of another. Thus, for example, a subclavian aneurism has been cured by the pressure of a nascent tumour formed on the arteria anonyma; but, perhaps, indeed, it were an error to apply the term cure to such an event. A more favourable result is the third variety of pressure; when a tumour, not aneurismal, and unconnected with the vessel—probably an enlarged gland—compresses the artery, or artery and aneurism both, so as to induce coagulation in the cyst. The principal disease is cured; and the secondary formation, the independent tumour, may be dealt with afterwards, if it be deemed advisable. 2. By occlusion of the aperture of communication; independently of pressure, or moderation of the arterial flow. A firm portion of coagulum becomes detached from the fibrinous mass occupying the interior of the cyst, and is impacted in the aperture; either preventing, or greatly limiting, the arterial influx; and obviously favouring contraction and solidification of the tumour. The artery itself may remain pervious or not; more frequently it also is occluded. To this result it is plain that a smallness of communicating aperture is very favourable; and were we at all times able, by auscultatory and other signs, to ascertain the dimensions of the aperture, we might more truly predicate, in those cases of internal tumours which are inaccessible to surgical interference, the result of treatment with the view of obtaining spontaneous cure. 3. By inflammation and gangrene of the cyst; not partial, but including the whole. Gangrenous inflammation of the aneurismal cyst may occur spontaneously, or be the result of external injury. It may follow ligature of the artery; and then it not only involves the whole diseased formation, but includes the whole limb as well, demanding amputation. But with this we have nothing to do at present; treating not of the surgical, but of the spontaneous cure. If

the slough include the whole cyst, a fortunate issue may be predicated; the dead part separates in the usual way; not until the surrounding living textures have become densely infiltrated by fibrinous exudation; and not until, by such plastic exudation, all the implicated blood-vessels, including the artery at the aneurismal part, have been consolidated. As the slough separates, consequently, no hemorrhage ensues; and healing advances in the ordinary way. Profusion of purulent formation is the principal danger; when the suppurated part is large, and the patient already low in system. Hectic may ensue. If the gangrene be but partial, there is the greatest hazard; on separation of the slough, the open cyst and artery will be exposed; the hemorrhage will be great, and probably fatal. 4. By the aneurism becoming diffuse. As formerly observed, if suppuration or gangrene do not occur, the pressure of the diffusely infiltrated blood on the cardiac portion of the artery may so restrain its flow, as greatly to favour the occurrence of spontaneous cure.

II. *The Surgical Treatment.*—Spontaneous cure, by any mode, is comparatively of rare occurrence; and is not to be trusted to in practice, when other means are in our power. In olden times, the surgeon did not hesitate to interfere directly and boldly. In the time of Celsus the tumour was opened by the knife; and, to restrain the frightful hemorrhage, a heated cautery was thrust into the wound. Or, as practised by Rufus and Antyllus, the aneurism was cut into and cleared out, the vessel having been previously secured by ligature above and below the aneurismal part. After the introduction of the tourniquet by Morel in 1674, the procedure became somewhat less formidable; hemorrhage being restrained by the pressure above, until the artery had been secured, at least temporarily. Or, finding these direct modes of operation very disastrous in their result, as might well have been anticipated, it was not unfrequently deemed expedient at once to amputate the limb, above the aneurism—rather than encounter the certainty of hemorrhage after deligation, and the probability of bleeding along with the certainty of exhausting suppuration after the cautery. But as the nature and treatment of disease became better understood, this department of practical surgery improved. About the middle of the eighteenth century, the operations for aneurism became less savage in themselves, and more happy in their results. In 1740, Anel—doubtless having become aware, that, for the establishment of cure, it is not essential that the sanguineous flow should be entirely arrested in the part—cut down above an aneurism at the bend of the arm, and, securing the artery there, without opening the sac, effected a cure. Be it remembered, however, that this was an example of false aneurism; and that consequently the arterial coats, where tied, were not necessarily in a degenerated state, as they must ever be in the immediate vicinity of the true aneurism. For John Hunter was reserved the sole merit of the true improvement in the operation. He, reasoning farther on the fact, that complete arrest of flow is not essential to cure, saw how this enabled him to seek for a healthy portion of artery on which to apply the ligature, one capable of plastic exudation, and not prone to ulceration; that it was not imperatively incumbent on him to tie the vessel

immediately above the true aneurism, where its coats must be diseased ; but that it was in his power to select a portion higher up—removed, perhaps, to the extent of several inches. Of this power of selection he did not fail to avail himself ; and in 1785, in a case of popliteal aneurism, instead of securing the artery in the ham, he tied the femoral near the middle of its course. Although the practice proved at first unsuccessful—the mode of operation, not the reason why, being defective—the soundness of the Hunterian theory stood unshaken ; and the subsequent experience of Dessault, and others, with operations better executed, obtained for it ample confirmation.

The original want of practical success resulted from the faulty mode in which the ligature was used. There existed an excessive dread of injury to the arterial coats, by a small ligature tightly applied ; it was feared that they would be cut through too soon, ere yet the canal had become consolidated, and that the most serious hemorrhage would ensue. Accordingly, broad tapes were used ; others were applied loosely, to be tightened as circumstances might demand ; and in an over-anxiety to save the arterial tissue, it was unduly detached and manipulated, so as to ensure either ulceration or sloughing, and thence the much-dreaded hemorrhage ; the means adopted to prevent this turning out the most likely to ensure its occurrence. Success depends mainly on the skilful use of the ligature ; and too much caution cannot be used in its application. The vessel is exposed by careful dissection, somewhere on the cardiac side of the aneurism ; not so close as to endanger the encountering of degenerated coats ; not so far removed, as to favour too free a collateral supply of blood still remaining in the tumour. The external wound should be rather too large than too small ; facility and safety of performance being closely allied in this operation. The incisions are made with a small finely-edged scalpel, used lightly ; neither directors nor blunt knives should be employed, for they must bruise and tear to a certain extent ; and the simpler and smoother the cut is, the greater is the probability that both wound and artery will assume a salutary action. The vessel having been exposed, its sheath—pinched up by dissecting forceps—is opened to the extent of about half an inch ; and by repeated touches of the knife's point, assisted by the forceps, the arterial coats—looking white by the insulation—are completely detached from all neighbouring tissues ; only, however, to a very limited extent ; not more than what is barely sufficient for the passage of the needle and ligature. The aneurism-needle should have its point neither too sharp, to endanger wounding of the arterial coats ; nor too blunt, to render tearing and force necessary for its passage. Armed with a firm round ligature, of silk or thread—well waxed, to facilitate its application—it is gently insinuated beneath the artery at the detached point ; great care being taken to exclude all textures, save the arterial, from within its circuit ; more especially nerves and veins. Having passed, the ligature is laid hold of, and retained, while the needle is withdrawn. The loop of the ligature is then cut, and one half pulled gently away ; the remaining portion is secured on the vessel with a reef knot ; drawn with sufficient tightness to afford to the operator's fingers the peculiar sensation of the internal and middle coats

having given way. One end is cut off close to the knot; the other is left pendent. The wound is brought carefully together by suture and adhesive plaster—leaving the protruding end of the ligature readily amenable to both sight and touch—and is treated so as to promote adhesion. The limb is placed in a relaxed and comfortable position, and so retained. In the case of deep-seated vessels, the more complicated needles of Weiss, Trant, &c., may be found very useful; but in the majority of cases, the ordinary instrument and ordinary skill suffice. The ligature is not interfered with until the usual period for its separation has elapsed; from ten to twenty days. Then its free extremity is to be gently touched; if found loose in its deep part, it is carefully withdrawn; if still adherent, no pulling is employed; we wait patiently the spontaneous loosening; and as in the case of dead bone, regard it as our duty to interfere and take away, only when the natural process of detachment has been completed.

By some it has been considered preferable to employ two ligatures, dividing the artery between; a modification in the deligation of arteries, as old as *Ætius*, and strenuously advocated by *Abernethy*. This mode of operation, however, does not seem to possess any superiority to that above recommended, if the latter be well performed. If the position of the limb be duly attended to, relaxation of the artery can be obtained as well in the one case as in the other. But if the operation have been improperly conducted; that is, if in our attempts to expose the vessel cleanly, it have been detached too extensively from its surrounding connexions—thereby rendering the occurrence of either ulceration or sloughing more than probable—let two ligatures certainly be applied; one at each extremity of the separated portion; and the artery may then be divided or not between, as may seem expedient.

The effects of the ligature, well applied, are as follow:—There is mechanical arrest of the arterial flow at the deligated point, at once throwing a stress on the collateral circulation, and, by weakening the main current, on the distal aspect of the ligature, favouring coagulation of the aneurismal contents, with solidification of the tumour. The internal and middle coats are at once cut through; the former cleanly, as if with a knife; they resile on each side of the ligature, and the noose of this embraces only the external coat. The cut surfaces of the internal coat are kept in close contact; and, being cleanly incised, in close apposition, and free from compression by the ligature, they unite by adhesion. Fibrinous exudation takes place for this purpose, extending a little distance on each aspect of the ligature; it becomes fully organized; and thereby the arterial canal, at that part, is permanently and firmly occluded. And this process of exudation, organization, and consolidation, is facilitated by means of a coagulum, formed almost immediately after the application of the ligature. On the cardiac aspect of the ligature, the blood is thrown into a condition of comparative stillness, favourable for coagulation, up to the nearest collateral branch; and the result is, the production of a slim and tapering clot; its base resting on the arterial tissue at the deligated point; its apex loose, and nearly on a level with the nearest collateral branch. This—slender though in most cases it is—will doubtless have the effect of removing

the blood's impulse from the site of exudation and organization, and will so facilitate completion of the process of occlusion. From this it is obvious how anatomical knowledge may often be of service, in directing the selection of the site of deligation, to a point where no collateral branch is given off in the immediate and cardiac vicinity. Otherwise, there might be, instead of remora, an increased tumult of circulation, at the part which is undergoing the process of obstruction.

The plastic exudation is not limited to within the vessel; it occurs, and more extensively, on its exterior; forming a dense swelling of some size, within which the ligature's noose is deeply imbedded. But the portion of cellular coat included in that noose is necessarily killed, by the mechanical injury; and, being dead, it must be separated. Detachment is effected in the ordinary way; by inflammation and ulceration. These destructive actions extend no further on either side of the ligature, than what is sufficient for detachment of the foreign body, with the dead portion of arterial tissue. And no accident by bleeding occurs, for two reasons; first, on account of the limited extent of the ulceration; second, because the arterial tube has been, at that part, and someway beyond it, completely consolidated. Thus the ligature, and the dead portion of cellular coat embraced by its noose, are detached from the living texture. There may be a slight obstacle to extrusion, from the external fibrinous deposit—threatening to confine, as the substitute bone often does the sequestrum—but the slightest touch of the free end of the ligature suffices to counteract this. On the ligature's final extrusion, the hiatus, so occasioned, is quickly filled up by fresh exudation; and all is consolidated. A dense compact swelling, of some size, thus comes to occupy the place of the arterial tube, at the deligated point. Such copious effusion and consolidation were essential, as has been seen, to prevent accident by hemorrhage during ulcerative separation of the ligature. But now that this event has been safely achieved, the fibrinous mass is found gradually to diminish by absorption, and at length almost entirely to disappear; like provisional callus, in fracture; the existence of any salutary adventitious growth usually ceasing with its usefulness. Ultimately, so far from there being a swelling or induration at the deligated point, that portion of the artery is found dwindled down to a mere thread, and the normal texture of the surrounding tissues is almost wholly restored. Above and below the obliterated portion, the vessel's calibre gradually contracts, till the nearest collateral branch is reached; and there the normal dimensions are usually restored. The internal coagulum shrivels, and ultimately disappears, by absorption.

Thus it is plain, that the main object in conducting the operation, and subsequent treatment, is in truth maintenance of a low grade of the inflammatory process, and prevention of true inflammation; attainment of plastic deposit, and the averting of suppuration and ulceration—except what barely suffices for separation of the ligature and its included slough.

Such are the effects of ligature on the artery itself; when well applied, on a sound portion; and it is the chief advantage of the Hunterian mode of operation, that it enables us to select the site of operation,

with a view to the latter indication. The effects on the tumour are, instant arrest of the pulsation and bruit; subsidence as well as silence of the swelling; and gradual induration of it, obviously by coagulation of the contents. This chain of favourable events, is the result of the main current having been abruptly turned aside into the collateral channels. And it may happen that the process of cure, thus begun, proceeds rapidly to completion without even a semblance of interruption; but more frequently it is otherwise. The collateral circulation existed previous to the aneurismal formation; but it became more full and free immediately thereafter; and its increase may, in the great majority of cases, be said to have kept pace with the increase of the tumour. A third and more decided enlargement follows on the performance of the operation; the collateral channels are for a time strained, as it were, until they have accommodated themselves to the increase of their burden. At first the temperature of the limb falls, in consequence of the arterial influx being for a time actually impeded and impaired; but, subsequently, it rises even higher than the previous standard; the arterial circulation not only having resumed its wonted copiousness, but also being much more uniform in its distribution than before; and the superficial vessels, especially, being more plentifully supplied. Some of these, before scarcely appreciable, may be both seen and felt pulsating vigorously. Sometimes, the temperature again falls beneath the standard of health. In consequence of the re-establishment of the limb's circulation, pulsation often returns in the tumour; blood having freely come again into the cyst, and into the main vessel on the distal aspect of the ligature, by the circuitous route. The ligature never wholly arrested the sanguineous flow there, even for a moment; collateral circulation is at all times too free to admit of this; it was only moderated; and this moderation, conjoined with removal of the heart's impulse, was sufficient to originate the process of solidification, and temporarily to withdraw pulsation from the tumour. Complete arrest of the flow is not essential; nor indeed is it desirable. We do not desiderate an empty condition of the aneurismal cyst, but that it should be filled by solid contents; and, to afford this pabulum for solidification, a certain amount of circulation is expedient; slow and dull, to favour coagulation; and without energy of impulse, so as to maintain no distending or expansive effect on the cyst. But, after a day or two, the freedom and fulness of the circulation is often such as to restore a diminished impulse to the swelling. This need be no matter of surprise; neither let it give rise to unnecessary alarm. The chance of injury thereby is readily obviated, by applying a moderate and uniform pressure on the part, by means of careful bandaging; of course, beginning the application of the roller at the furthest extremity of the limb, and leaving no part unsupported. In a short time, pulsation again ceases; solidification is completed; and the disappearance by absorption advances, in the manner formerly described.

Such is the modern operation for aneurism, and the effects which are expected to issue from it, when properly conducted. But there are both a preparatory and a subsequent treatment, of much importance; neither of which can ever with safety be neglected. A patient is not

to be taken from his ordinary avocations, and at once subjected to the operation. For some days he should be kept in a state of repose ; his bowels and general secretion should be attended to ; his diet should be restricted, and all stimulant fluids absolutely prohibited. If there be a fulness of the circulation, or any apparent tendency to vascular excitement, either a moderate bleeding should be practised, or a moderate antimonial exhibition enjoined. After the operation, complete quietude of both body and mind is maintained, and every other means taken likely to ensure a gentle and moderate state of the general circulation ; this being obviously favourable to the advancement of the process of cure. And about the usual time of the ligature's separation, all moral and physical causes likely to accelerate the circulation suddenly and much, should be especially avoided. The regimen is strictly antiphlogistic. The limb is placed and retained in a relaxed and comfortable posture. No severe pressure is applied to the tumour, under any circumstances, lest suppuration or gangrene be induced ; and no pressure in any degree need be employed, unless either pulsation return soon after the operation, or, at a later period, diminution of the tumour become slow and unsatisfactory. Nor should manipulation of the tumour be frequently and rudely practised, otherwise suppuration of the cyst is not unlikely. It is no doubt essential to watch the condition of the swelling, and it is satisfactory to know that pulsation is absent, that solidification continues complete, and that diminution advances favourably ; but such knowledge can be readily enough obtained, without rude handling. All impertinent curiosity should be rigidly abstained from by the surgeon, and strictly prohibited on the part of others. Stimulant frictions, or more direct applications of heat, may perhaps be thought of immediately after the operation, the temperature of the limb having fallen considerably below the normal standard. There can be no worse practice. At this time, vital power in the limb is very low, and if the stimulation induce any considerable amount of vascular excitement, as is most likely, gangrene is almost sure to follow. Either let the limb alone altogether ; or swathe it gently in a flannel roller ; the temperature, as already stated, of itself rallies ; and power, along with circulation, is gradually restored.

After deligation of the large arteries near the trunk, free venesection, perhaps repeated, is often advisable ; in order to save the important organs, within the great cavities, from the evil effects of sanguineous determination, caused by the sudden interruption of the main current. After ligature of the common carotid, for example, the lungs are in much danger by congestion ; which may induce an apoplectic state of that tissue, or pass on into pneumonia ; casualties, tending to a fatal result which can be obviated only by loss of blood.*

At one time it was a question, what period was most favourable for operation ; and in general it was held that some considerable delay was advisable, in order to permit the collateral circulation to have become fully established. But it is now well understood, and generally admitted, that so soon as there is aneurism there is collateral circulation ;

* London and Edinburgh Monthly Journal, January, 1842, p. 1.

more likely to prove excessive, and cause trouble and anxiety by undue return of pulsation—than to be deficient, and induce gangrene directly by failure of arterial supply. Gangrene is certainly one of the dangers of the operation; but in the great majority of cases in which it has occurred, it has not been the direct but the indirect consequence; not by insufficiency of arterial supply, but by induction of over-action; not by the fault of the operation, but by that of the surgeon in his subsequent treatment. The limb has been rubbed, heated, or otherwise stimulated, prematurely and to excess. Delay is *unnecessary*, on account of collateral circulation; so soon as the tumour is observed, it may be made the subject of operation, provided the other circumstances of the case are favourable. And further, delay is *inexpedient*; for the older the aneurism, the larger the tumour, and the greater its deleterious consequences both on the part and on the system. By early operation, we save constitutional irritation; as well as displacement, interruption of function, and change of structure, in the parts—perhaps important—adjoining the disease.

But cure may fail, even should the deligation itself succeed. Success is not invariable. 1. There may be an idiosyncrasy of system, whereby coagulation of the blood is prevented; a diathesis analogous to the scorbutic, or to that which is termed hemorrhagic. In such circumstances, the remedies tending to oppose that state must be employed; acetate of lead and opium, sulphate of soda, &c. 2. Or there may be a want of re-active pressure and support, on the solidifying tumour, by super-imposed textures. Thus, as has been well shown by Mr. Porter, aneurism of the upper part of the carotid is unfavourably situated in this respect; from a want of investing texture on the pharyngeal aspect, the tumour not only extends chiefly in that direction, during growth; but also, after operation, it may fail to solidify, contract, and disappear. Other aneurisms, when superficial, may labour under a similar disadvantage. Such deficiency is to be atoned for, as far as circumstances will permit, by the application of artificial pressure and support, by compress and bandaging.

Other methods of treatment, which have been and still are in use, now claim our attention. The operation of *Brasdor*, is the reverse of that of Hunter; the application of ligature, not on the cardiac, but on the distal side of the tumour—in its near proximity. Obstruction occurs at the point tied; coagulation and remora of the arterial contents will take place up to the nearest collateral branch; and, if there be no branch given off between the tumour and the point of deligation, the former will obviously be included within the range of delayed and coagulating blood, favourable for origination and advancement of the process of cure. If, however, any branch of considerable size do interfere, it is equally plain that the effect of the deligation will be to cause an increased turmoil at and within the tumour, and to aggravate the disease accordingly. Also, much difficulty may be experienced in cutting on the vessel; it may have been already obliterated; it may be much displaced from its normal relative position; in the great majority of cases, as formerly stated, it is certain to be somewhat diminished in size; the surrounding parts may have been the seat of a chronic form

and low grade of the inflammatory process, and the vessel may be intimately blended with the condensed and infiltrated structure. This mode of operation, then, applied generally to aneurism, is obviously and vastly inferior to the Hunterian. Yet its employment is occasionally expedient. When an aneurism is situated so close to the trunk, as to preclude the application of ligature on its cardiac side, are we to abandon all hope from surgical interference, and content ourselves merely with medical treatment in the hope of facilitating the accession of spontaneous cure? Instead of thus, as it were, leaving the patient to his fate, we may practise the distal operation; if the circumstances seem otherwise favourable; and if the patient, after having heard an honest explanation of the risk, is willing and anxious that the attempt should be made. In aneurism, for example, of the common carotid at its origin, experience tells us that we need not attempt the Hunterian operation, by ligature of the anomya; that is certain to fail. Brasdor's operation, on the contrary, is not unlikely to succeed, inasmuch as there is a long space of the carotid from which no branch is given off; and consequently no vessel is likely to intervene between the tumour and the distal ligature. Even in favourable circumstances, however, there is always one serious objection to this operation; in order to avoid the risk of an intervening collateral branch, or, in other words, to secure obliteration of the artery and aneurismal sac, it is essential that the site of deligation be not far removed from the tumour; and consequently there is a great probability of the arterial coats being unsound at the point tied. Ulceration and hemorrhage are the result. And the practical consequence is, that the statistical results of this operation are as yet far from satisfactory.

A modification of Brasdör's operation is usually associated with the name of *Wardrop*. In my humble apprehension, under all circum-



stances, inexpedient; because containing within itself the elements of certain failure. Supposing aneurism to exist in an arterial trunk, just

above its bifurcation—it is proposed to tie one of the branches only, and from that interference to hope for a favourable result. According to this system for example, in aneurism of the arteria anonyma, it would be held sufficient to tie either the subclavian or common carotid. Here there is a manifest certainty not only of a collateral branch, but one of very great size, intervening between the tumour and the ligature; a circumstance, as already seen, sadly hostile to success.

Temporary ligatures have been proposed; and trial, sufficient to establish their inexpediency, has been made by Travers, Dalrymple, &c. The temporary application is unequal to effect, with any certainty, occlusion of the canal at the deligated point; and the disturbance and injury done to the vessel, however short the time of application, is just as likely to induce ulceration and hemorrhage, as if the deligation had been permanent; perhaps more so, in as much as, besides mechanical interference in the application of the noose, there is added that which is necessary to effect its removal.

Thick and flat ligatures were at one time used to meet the false dread of premature division of the vessel's coats; an event of which experience has shown there is no danger, if the tissue be in even a tolerably sound condition. Draw a firm round ligature, as tightly as you may, the inner and middle coats alone yield; the cellular remains entire. A greater risk is that by ulceration or sloughing of the arterial coats, opening into a yet patent canal; plastic exudation being either wanting or imperfect. And that is mightily contributed to by the flat tapes; their application not only entailing extensive separation of the arterial tissue from its surrounding connexions, but also rendering it certain that a considerable portion must slough and separate, and that consequently no slight amount of suppuration and ulceration—the main danger—shall be inevitable ere the foreign substance can be detached. Although the high name of Scarpa was attached to such practice, it need excite no wonder that it has fallen into complete desuetude; as also the plan of interposing compresses, of various kinds, between the artery and the ligature. All such means increase the change of ulceration and sloughing; while, at the same time, the giving way of the internal coat is prevented. This tunic, being included, as well as the others, in the noose, is incapable of plastic exudation at that part, and must slough, inflame, and ulcerate.

Similar objections exist to exposure of the vessel by incision, and then, instead of deligation, applying graduated pressure directly to the tissue, by means of Dubois' *serre-nœud*, or Assalini's compressor; the practice had no success, and is obsolete.

It has been proposed to extend the principle of subcutaneous puncture to the deligation of arteries; passing a needle around, without any preliminary incision. By such a mode of procedure, there is obviously no safety for artery, nerve, or vein; it is consequently quite unwarrantable.

Ligatures made of animal substance, as catgut, have been used, and both ends cut away; in hope of the noose becoming absorbed. Others of a metallic nature have been employed, with the expectation that they would become encysted and quietly resident, as bullets and other

metallic substances not unfrequently do when lodged in the ordinary textures. Both forms of ligature, however, have hitherto been regarded by Nature as foreign substances, and extruded by suppuration accordingly.

Pressure, without incision. In ancient times, the surgeon who was afraid to cut into the aneurism, and take his chance of arresting the flow of blood, had recourse to direct and energetic compression of the part, with the hope of cure. The name of Guattani is chiefly associated with the practice. Local sloughing, suppuration, or ulceration, with severe constitutional disturbance, yet with an unclosed artery and aneurism, resulted more frequently than the cure. Subsequently to the establishment of the Hunterian operation, its principle was extended to the mode of treatment by pressure; this being applied, not to the tumour itself, nor in its immediate vicinity, but at some distance; at a part such as would be selected for Hunterian deligation, in the hope of the arterial tissue there being in a sound condition. This method was made trial of by Dubois, A. Cooper, Blizard, &c.; but with no satisfactory issue. The pressure was continued and severe; their object being to keep the tube close and impervious at that point, and by plastic deposit to obtain its complete consolidation. The result was, the occurrence of great pain and constitutional disturbance; followed by inflammation, ulceration, or sloughing of the compressed parts; exposing, or perhaps including, the vessel. The practice found no favour with the general profession. Lately, however, the treatment by pressure has been revived, in a more scientific form, and with a better success; conducted rather as if itself were not the agent of cure, but only the means whereby the spontaneous cure may be originated and favoured. The pressure is made at a Hunterian site, as before; but it is neither constant nor severe. By means of a compressor, such as invented by Crampton and Signoroni, or any other suitable apparatus, a moderate degree of pressure is applied to the vessel at a point where its coats may be expected to be sound, and consequently not prone to ulcerate from slight causes. This is maintained, so long as it can be conveniently borne by the patient; but no longer. So soon as the uneasy sensations become at all intense, with swelling and numbness of the limb, and throbbing in the part, the pressure is either slackened or altogether removed. After a time, the parts having recovered, it is re-applied; again it is removed; and thus, by its occasional and modified use, the disasters formerly attendant on the treatment by pressure may be altogether avoided. At the same time, the circulation in and near the aneurism is decidedly moderated, so as to favour solidification. The tumour is not only arrested in its growth, but begins to diminish; its pulsation is less, and its dimensions contract; it feels harder and less compressible; ultimately, pulsation wholly disappears, and induration is complete; absorption then advances, and the obliterative cure is obtained, with or without a pervious condition of the vessel. But the pressure is not trusted to alone. The same preparatory treatment is necessary as before the operation by ligature; and, throughout the whole period of treatment, absolute repose with recumbency is maintained, as well as antiphlogistic regimen, and all other means likely to favour the desired beneficial change.

Also, the limb below the compressed point must be uniformly and equably supported by bandaging, lest passive congestion and œdema supervene; and this pressure may from time to time be somewhat increased on that part of the limb which includes the aneurismal tumour. Let no haste be indulged in. The process is necessarily one of weeks, not of days; gradual, not sudden; interrupted, not continuously progressive. The pressure requires to be neither great nor constant, for we do not desire obliteration, even temporary, of the arterial tube there; it is sufficient to moderate, not essential to obstruct, the flow. And only by a constant remembrance that such are the principles of cure by this means, will the pressure be so leisurely and prudently conducted, as to ensure avoidance of the disaster to which compression is liable. The advantage of such a mode of treatment, when properly conducted, is immunity from ulceration and hemorrhage; the disadvantages are, the protracted period, and ultimate uncertainty, of cure. If improperly conducted, it is in every point of view inferior to the ligature; less certain of cure, and even more certain of danger at the selected part of the vessel. Even skilfully managed, it is obviously less capable of general application; there being not a few systems possessed of an intolerance of pressure, even when modified and occasional. The improved revival, however, is as yet but in its infancy. In the hands of Liston, Cusack, Hutton, and others, it has already succeeded.* But a wider experience is still required, ere surgical opinion can be at rest upon the question. The leading points of the system, it may be again stated, are:—the pressure is at some distance from the tumour, moderate, and only occasional; it is not necessary, and it is not our object, to obliterate the vessel at the compressed point; in other respects the same treatment is followed out, regarding both part and system, as in the favouring of spontaneous cure without any surgical interference.

Cold has been applied continuously to the tumour; in the hope that contraction of the cyst and solidification of its contents would be thus favoured. The contemplated advantages are not obtained; and danger by gangrene is rendered imminent. The insertion of a *seton* in the tumour has been tried; and there is no need to repeat the experiment. The same may also be said of acupuncture; with or without the passing of galvanism or electricity through the tumour. The certainty of danger incurred, is not compensated by the probable advantage.

Amputation—not unfrequently resorted to in this disease by the old surgeons—is still preferable to all other modes of treatment, under certain circumstances. 1. When bone has been hopelessly involved, by the progress of the tumour; true caries have been established, in such a site and to such an extent as to preclude the use of the ordinary means of cure. 2. When the diffuse form of aneurism has occurred to a great extent; so that it becomes plain that absorption and consolidation cannot remedy the evil, and that great as well as extensive inflammation must occur in the infiltrated tissues. Even supposing the aperture in the vessel to have been closed, the suppuration and hectic would be certain ultimately to demand amputation. And should the

* Dublin Journal of Medical Science, May, 1843, p. 364. Lancet, 1052, p. 106. Ibid. 1073, p. 24.

aperture remain unoccluded, danger to life by hemorrhage would come at an earlier period ; with the first evacuation of the purulent fluid.

3. When disease of the vein co-exists, impeding venous returns. If by the operation of deligation, in such a case, we at the same time impede the arterial influx—although only imperfectly, or for a time—it will be difficult to avert the occurrence of gangrene, as a direct and almost immediate result. Amputation would be demanded, on account of spreading gangrene ; under circumstances which afford but slender hope of success. It were better to amputate at once, and anticipate disaster. 4. When a large aneurismal sac has suppurred, in a patient already weak. Suppuration of the entire cyst is one of the modes of spontaneous cure. When the suppurred surface is of no great extent, the secretion not profuse, and the frame robust, the cavity usually fills up and consolidates. But if the surface be large, secretion great, and the system already worn, hectic is almost certain to occur, of so formidable a nature, as to demand sacrifice of the limb in order to save life. 5. When gangrene threatens, from any cause ; of the limb ; not of the tumour only—for this latter, as formerly explained, may prove the means of a spontaneous cure.

We now come to consider the casualties of the ordinary operation by ligature. And the foremost of these is hemorrhage.

Secondary Hemorrhage.—This may be variously induced. 1. By sloughing of the arterial tissue. The artery has been too freely and extensively detached from its surrounding connexions ; it loses both its mechanical support, and, by imperfect nutrition through vascular supply, its vital power. A certain amount of the inflammatory process necessarily follows the injury done in operation ; there is no sufficiency of power in the inflaming part to resist or control ; it perishes ; and, on separation of the slough, a gush of arterial blood discloses the open condition of the artery. Thus is occasioned the earliest form of bleeding ; occurring within a few days after the operation. A large space of vessel being usually opened, the flow may prove at once fatal ; more frequently, however, it remits, and by repetition exhausts the patient. 2. By ulceration at the time of the ligature's separation ; usually between the tenth and twentieth days. How this may occur has already been explained ; from want of plastic exudation, on the one hand ; and from proneness to ulceration, on the other. It may be the fault of the artery ; the coats at the deligated point being so degenerated, as to be quite incapable of the required salutary change. It may be the fault of the operation ; the coats having been too much detached ; not enough to induce sloughing ; but quite enough, to carry the inflammatory process beyond the stage of plastic exudation, into that of suppuration and ulcer. It may be the fault of the ligature ; too broad and clumsy in its nature ; not dividing the internal coat, so as to permit resilience and coaptation of the cut surfaces, favourable for adhesion ; and, by necessarily producing a large slough of the included tissue, rendering a proportionably great amount of inflammation and ulceration necessary for detachment. Or it may be the result of accidental circumstances, over the accession of which we have little or no control ; as erysipelas, purulent infiltration, febrile disorder, &c. Practically, it is important to

observe, that in this form of bleeding the flow is, in the great majority of cases, from the distal side of the ligature. There, doubtless, the vital power of the tissue is more depressed than on the opposite aspect; for the immediate effect of the tightening of the ligature will plainly be, to interfere with both nervous and vascular supply in that part of the arterial tissue. On both sides, inflammation and ulceration must ensue; to detach the noose and included slough; and on that side, where power is least, the morbid action will be most rapid and extensive, while surrounding plastic exudation is most defective. On the distal side, the coats are likely to ulcerate more rapidly and widely than on the cardiac; and while on the latter aspect the tube is shut, at and beyond the line of ulceration, on the former it may be open and ready to bleed. 3. Or the hemorrhage may be altogether independent of the ligature's separation; occurring either before or after that event, more frequently after. Abscess forms in the textures around; it enlarges, and includes the vessel; the plastic exudation is interrupted; and by the pressure of the abscess ulceration is effected in the arterial coats, from without, opening into the pervious canal; it may be, above or below the ligature, according to circumstances. Were the practice followed, as advocated by some, of cutting off both ends of the ligature, after its application; and were the wound to adhere completely in its external part by adhesion—it is very plain that this casualty would thereby be rendered very probable. The noose would act as a foreign substance, after, as well as during and before its separation from the living arterial tissue; it would become the cause and centre of an acute abscess; that abscess, cooped up and confined by the closure of the external wound, would, by extension, implicate the vessel more and more, and too probably at length effect an ulcerated aperture into a pervious portion. By this time the external wound has again opened; or it may have been but partially shut; and the hemorrhage is free.

Secondary bleeding by ulceration is often preceded by a marked febrile accession; a circumstance of no little interest to the practitioner, as forewarning him of the coming danger; sometimes placing it in his power to avert it altogether; in all cases enabling him to be prepared to meet the emergency. Secretion is arrested, the pulse becomes full and throbbing, the head pained, the face flushed; the patient is restless, anxious and alarmed, and complains of a tightness about the chest. Then comes the hemorrhage. "When unexcited he lies pale and exsanguine, yet at the same time excessively irritable and anxious; but whilst under the influence of the febrile paroxysm, his face is flushed, his skin hot and dry, his pulse tight and bounding, but affording a peculiar sensation resembling a double beat; and it is during a period of such exacerbation that each successive hemorrhage occurs."* Such fever is seldom absent, when hemorrhage has taken place, and continues by repetition. But the first occurrence is sometimes preceded by no febrile state whatever: the flow coming, without any note of warning; perhaps seeming to be induced by some movement of the patient, in changing posture.

* Porter.

The hemorrhage may spontaneously cease. More frequently, however—and sometimes even when active and suitable treatment has been employed—it recurs once and again; and the patient dies exhausted, partly from the direct effects of loss of blood, partly from the disorder of system which the ex-sanguine state has induced.

Treatment.—In the first instance let it be prophylactic. The preliminary febrile paroxysm is marked and met. Bleeding from the arm is practised, if not otherwise strongly contra-indicated; of such an amount, and so abstracted, as to produce a decidedly sedative effect on the heart's action, and on the general circulation. And this sedative effect is maintained, by the subsequent exhibition of a full opiate. Thereafter, aconite or belladonna may be advantageously used, to prolong and perhaps increase the beneficial effect which bleeding and opium in the first instance induced. By thus calming the tumult of the circulation, at the suspected point as well as elsewhere, an additional opportunity may be afforded for occlusion by suitable exudation, ulceration having ceased; or if bleeding do occur, it will be in a comparatively moderate and diminished flow.

When the dreaded casualty has taken place, the treatment varies according to the nature of the cause. 1. If it be according to the first, as formerly stated, we need have no hesitation in tying the vessel afresh, at a higher point, if that be in our power; and, at the same time, direct pressure is to be applied to the bleeding orifice; exact, direct, and graduated, by means of compress and bandage. As a general rule, it may be here stated, that pressure, in the case of secondary bleeding, if exact, need not and ought not to be severe; exactness, combined with moderate intensity, will be sufficient to arrest the flow, and to induce fibrinous exudation to fill the chasm; a higher force would not be more effectual as a hæmostatic, and would probably cause renewal of ulceration or sloughing in the compressed arterial tissue; occasioning repetition of the casualty by renewal of its cause. 2. In the second form of secondary hemorrhage, if we are certain that the bleeding comes from the distal aspect of the ligature, as in most cases it does, little benefit need be expected from an additional ligature on the cardiac aspect; and this procedure, therefore, is not adopted, in the first instance. The wound is cleared of coagulum, and enlarged if necessary, so as to expose completely the bleeding point; and this is overlaid by a graduated compress, retained so as to exert that degree of pressure which we have just seen to be most expedient; in all cases, the rest of the limb being duly supported by bandaging. In many cases, this will succeed; when conjoined with the general treatment suitable for maintaining a gentleness and tranquillity of circulation. Should it fail; then, as a last resource, let a fresh ligature be placed on the cardiac aspect, by a fresh wound, while the pressure is maintained as before. The second ligature may succeed in stanching the flow; but, in its turn, it may prove the cause of a second bleeding, by renewal of ulceration at the newly deligated part. Let there be no despair, and inactivity in consequence. So long as space permits, let ligature follow ligature on the cardiac aspect; and it is quite possible that in the end success will still be ours. Examples of such perse-

verance in surgery, well rewarded, are by no means unfrequent.* 3. In the third form of secondary hemorrhage, let the abscess be speedily evacuated; then, if there be room, place a ligature on the cardiac side; and maintain direct and moderate pressure, over the bleeding point. If second deligation be impracticable—as too often is the case, this form being most frequent in the deep-seated vessels, as those at the root of the neck—pressure must be trusted to alone, along with the general treatment.

Phlebitis.—Another casualty, scarcely less alarming, which may follow deligation, is inflammation of the concomitant vein. If the phlebitis be of the worst kind—diffusely suppurative—this of itself at once imminently perils existence. And, supposing only the simplest form to occur—that which terminates in thickening of the coats, and occlusion of the canal at the point affected—gangrene is rendered probable; pervading the whole limb, and demanding amputation. This danger should ever be borne in mind in conducting the operation. The vein should be studiously avoided, and left undisturbed, by forceps, fingers, knife, and ligature. As already stated, it is of much importance, as regards the artery itself, that its tissue alone should be included in the ligature's noose. And as regards the success of the operation, it is not less important, that the surrounding tissues should be uninjured; but of these, most especially the vein. Phlebitis, once excited, under such circumstances, will scarcely be within our control, so as to avert the evil consequences.

It may happen that, some days after the operation, both patient and practitioner are alarmed by the sudden occurrence of strong pulsation in the wound; not connected with the state of either the artery or aneurism, but entirely muscular, intermittent, and not synchronous with the arterial pulse. Alarm on such ground is unnecessary. In a short time, some simple antispasmodic having perhaps been given, and quietude maintained, the normal state is restored.

Treatment of Aneurism beyond the reach of Surgery.

Not unfrequently aneurism is so situated as to be amenable neither to pressure, nor to deligation, of any kind. In such cases, the issue is likely to prove untoward; the disease continuing to advance, till death ensue by one or other of the methods formerly noticed. Yet there is hope of spontaneous cure. And, further, we have means in our power whereby that event may be favoured; the science, not the art of healing, being brought into play. Our object is to oppose the tumour's increase, and favour its becoming consolidated and impervious. The obvious mode of accomplishing such an end, is to moderate circulation in general, at the same time promoting coagulation in the part. General blood-letting is advisable; but not to excess, otherwise the tumult by nervous re-action will result. A full bleeding is taken from the arm,

* Amongst others the following:—London and Edinburgh Monthly Journal, vol. 1, p. 336. Ibid. vol. 3, p. 109.

but not to actual syncope ; and is followed by an opiate. The sedative effect of a full bleeding is desired ; and it is probably of some consequence also to diminish, even temporarily, the actual bulk of the circulating fluid. Aconite or belladonna will be useful in maintaining the state of depression ; the dose being, of course, regulated by the effect produced. Food is scanty, simple, nutritious, and non-stimulant ; sparing, in order not to restore full-bloodedness ; simple and sparing, so as not to excite the circulation ; not too meagre, otherwise a thinness of blood will result, very unfavourable to the occurrence of coagulation, and consequently hostile to not the least important indication of cure. A due proportion of the fibrin is essential ; and nicety of management is plainly necessary to secure this, and yet maintain a gentleness of circulation. Acetate of lead with opium is given internally, in sustained doses ; tending both to moderate the blood's flow, and to induce coagulation, where the current is most sluggish—within the aneurismal cyst. Digitalis, colchicum, and other sedatives to the circulation, may also prove of service. Regulation of the bowels is not to be neglected ; but all drastic purging should be abstained from ; for, though at first a sedative effect may be thus obtained, excitement of the circulation is almost sure to follow. Repose of both body and mind is carefully maintained. The nature and object of the treatment is explained to the patient, and his intelligent yet not over-anxious co-operation secured. By long, patient, and skilful perseverance, he may be rewarded by a cure ; but, unfortunately, even under the best management, this is rather the exception than the rule.

Treatment of False Aneurism.

The most common form of this being the result of wound in venesection, at the bend of the arm, to that our attention may be directed. Prevention of the aneurismal formation is in our power, if the case be seen at the moment of injury, or even soon thereafter. Firm pressure is made with the thumb over the puncture, while an assistant is busy encircling each finger of the wounded member separately in a bandage ; these bandages meet in the palm ; a roller is then carried from the hand upwards, until the site of puncture is reached. A graduated compress of lint is placed accurately over the wound, the compressing finger or thumb being cautiously removed for this purpose ; and the compress is retained securely in its place by the roller ; the bandaging being made considerably tighter there, than on the rest of the limb. Energetic pressure, as well as accurate, is required ; and the previous bandaging permits us to exert that with impunity ; without it, even moderate compression cannot be borne safely for any length of time. Gangrene has ensued from the omission. The dressing is retained, in a state of firmness and efficiency, for several days ; when it may be re-applied somewhat more slackly ; but it should not be altogether discontinued for two or three weeks. Our object is to shut the arterial canal entirely, at the wounded part, both temporarily and permanently ; first by mechanical apposition, afterwards by fibrous exudation. And at the same time all

aneurismal formation is manifestly frustrated; the pressure being accurate and effective from the first, there is no infiltration or accumulation of blood in the cellular tissue, and no condensation of that into a containing cyst. No evil consequences are likely to follow such obliteration of the vessel at the injured part; and consequently it is a needless refinement in surgery, to attempt closure of the arterial wound only, by a more delicately conducted pressure. During such an attempt, it is more than likely that blood will escape from the puncture, and the aneurismal tumour become duly established.

Should pressure fail, or should no opportunity have offered for its employment, the tumour certainly forms. It is then to be dealt with by operation; by one of two methods, according to its character and period of duration. If it have existed long—for several years—and be of large size, and only partly compressible, it may be treated as a true aneurism, by deligation, on the Hunterian principle. The humeral is tied; pressure being at the same time employed directly on the part, applied in the same way as for prevention, but with much less intensity. If, however, it be recent, soft, and compressible, it is to be treated by direct incision; and this is the form which is most frequently presented, the patient being naturally alarmed by the pulsating swelling, and anxious that its growth should be arrested. A tourniquet, or the fingers of an assistant, having been applied to the humeral, in order to restrain hemorrhage temporarily, a free incision is made throughout the whole extent of the cyst, avoiding the super-imposed vein; the coagulum is turned aside, and the aperture of communication in the arterial coats looked for; if obscured, a slackening of the pressure above gives a jet of blood, which will readily disclose the site. By the point of the knife, the artery is carefully detached from the surrounding parts, the venous tissue being especially avoided; and a ligature is passed accurately above and below the punctured point. A full-sized probe, introduced into the aperture, renders the arterial tube more distinct, and facilitates its isolation by dissection. If the cyst be large, dense, and compact, it may be dissected away, either in whole or in part; the wound being then more favourably disposed for healing, without much, if any, suppuration. Pressure is removed; the wound is approximated, one end of each ligature protruding; and the treatment is conducted with a view to adhesion.

A variety of false aneurism sometimes occurs, termed *Varicose Aneurism*. The punctured aperture remains pervious in both vein and artery; the vein having been transfixed, and its superficial wound alone closing along with the integumental incision. The aneurismal cyst forms in the usual manner, but with a double communication; deeply, on the posterior aspect, with the artery; superficially, with the vein. In consequence, there is a mal-adjustment of the circulation at this part; arterial blood making good an entrance into the vein, whereby distention of the latter occurs to a greater or less extent. The symptoms are the same as in the ordinary tumour; with the addition of the varicose enlargement of the vein, and evident unusual activity of cir-

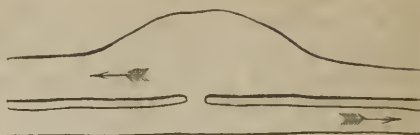
ulation within it; a peculiar thrill and bruit, being at the same time readily perceptible by finger and ear, compared by some to the noise of the fly-wheel of a musical box, by some to the purring of a cat, and by others to the buzzing of a fly confined in a paper bag; once felt, easily remembered. In other words, the aneurismal bruit is unusually distinct and palpable. The treatment is the same as that for the ordinary form of false aneurism; deligation, either direct, or at a distance on the cardiac aspect, according to circumstances.



A similar condition may be the result of ulceration. Suppose an artery and vein in juxta-position, as the abdominal aorta and vena cava. An aneurismal pouch begins to form in the artery, and extends in the direction of the vein, the cyst becoming incorporated with the venous coats; ulceration occurs in both tissues; and an aperture, more or less free, is established between the two vessels; entailing a constant and free commixture of their contents. Such a condition of parts, so situated, is plainly irremediable; spontaneous cure, by occlusion of the aperture, and consolidation of the cyst, is possible, but not probable; usually the result is fatal, by disorder of the general health, which the faulty circulation cannot fail to produce.

Aneurismal varix, is a second variety; and sometimes occurs at the bend of the arm. The artery and vein communicate, as in the former, but without any cyst interposed; the artery playing directly into the venous cavity. The swelling is less, but more diffused; the circulation is more plainly tumultuous; thrill and bruit are more or less distinct, according to the size of the communicating aperture; the varicose distention of the vein is great. Painful sensations, with some interstitial swelling, attend on the first formation; but subside gradually, and, usually, at length almost wholly disappear; the morbid state remaining in all respects stationary. The limb below the tumour is imperfectly supplied with arterial blood, a portion of the artery's contents entering the vein, and returning to the heart; the limb consequently is cold, numb, and vitally weak. By obstruction to venous return, also passive congestion and oedema are likely to ensue; at least for a time. By and bye, collateral circulation having become fully established, both arterial and venous, the healthy condition may be almost completely restored. In consequence of this comparative absence of inconvenience and growth, the case cannot be regarded as one demanding operative interference. Pressure is sufficient; to repress the swelling, and to moderate, if not prevent, the sanguineous intermixture. We have no hope of so occluding the aperture; palliation is our only object; repressing growth, removing uneasy sensations, and permitting use of the limb. Should, however, a case occur of unusual urgency, and the patient become dissatisfied with the palliative treatment, a direct incision may be made on the artery; and a cautious dissection having separated

its coats from the surrounding parts, above and below the aperture of communication, a ligature is to be passed and secured at each of these points. The affection itself is rare; and, still more so, are examples of it of urgency sufficient to render such operative interference even expedient.



Aneurism by Anastomosis ; Vascular, or Erectile Tumour.

This might have been classed with tumours, and its consideration deferred. Yet it comes naturally in connexion with diseases of the arterial tissue. The term denotes a diseased formation, in which the vascular tissue bears the most prominent part. There are varieties of such adventitious structure. 1. The capillaries of a portion of integument may be equably and permanently dilated ; producing discolouration, and but slight elevation of the affected part. Bleeding is copious from any breach of its surface, by ulcer, or by wound. This is one form of *nævus*, or congenital mark ; an affection of no danger, and but little inconvenience ; which may be looked upon as rather a deformity than a disease. 2. The structure may consist chiefly of dilated veins ; not over-distended, and mere passive tubes, as in *varix* ; but retentive of tone, and energy of function ; fed by arterial branches, of somewhat corresponding size and activity ; yet the latter tissue holding but a comparatively subordinate part in the development of the tumour. This morbid structure is not found in the substance of the true skin, like the preceding, but in the subjacent cellular tissue ; of various size and prominence ; causing a doughy elastic swelling, of a livid hue—the venous structure appearing with tolerable distinctness through the superimposed integument. If breach of surface take place, the hemorrhage is profuse, and chiefly of the venous character ; capable of being arrested by pressure, without much difficulty. If an incision pervade the mass to any considerable extent, arterial branches are found spouting with much activity ; still the main stream is dark and venous. Or the tumour may be submucous ; as exemplified by one kind of hemorrhoid, situated partly within and partly without the verge of the anus.

3. The third form of swelling is composed chiefly of dilated and active arteries ; supplied with large tortuous veins, placed in the vicinity ; the principal mass consisting of the changed arterial tissue ; the veins not properly constituting any part of this, but being rather the mere conduits whereby the arterial contents are conveyed back into the general circulation. Also, in the neighbourhood, are to be found the feeding arteries ; originally twigs, now enlarged to trunks ; pulsating strongly, and obviously carrying on a plentiful and active supply. The mass may be subcutaneous ; constituting the true aneurism by anastomosis or erectile tumour ; varying in bulk and tension, according as the circulation is sluggish or excited ; compressible ; elastic to the touch, and indicating its tubular structure on being pinched or rubbed when

in the flaccid state ; of a reddish hue ; in some parts tending to livor, but not continuously so, as in the preceding form of tumour. Or it may be submucous ; constituting the most frequent form of internal hemorrhoid. The structure is analogous to the normal erectile tissue ; but with this difference, that whereas in the normal, there are periods of complete repose and collapse, tension and fulness occurring but occasionally by local determination—in the morbid, there is never utter flaccidity and repose. The tumour is more full and tense at one time than at another ; yet at all times is full and active ; evincing an undulatory movement, if not actual pulsation. Strictly speaking, there is no aneurism here ; but rather a simple exaggeration of arterial tissue and function ; no degeneration of coats, but simply dilatation ; and yet not dilatation alone, but corresponding increase of function as well. The morbid formation may supervene at any period of life ; but most frequently it is congenital ; and, growing faster than the normal structures around, claims our attention at an early age. The most common situations are, beneath the integuments of the face, head, and neck ; not unfrequently it forms on the hands and feet. The tumour pulsates, synchronously with the heart's action ; but much less distinctly, and with less expansion, than the true aneurism ; it may be considerably diminished by equable and sustained pressure, resuming its wonted bulk on removal of the pressure ; a bruit is heard, dull and rough, and sometimes associated with a vibratory thrill. At first the skin is free ; ultimately it becomes involved in the morbid structure, and incorporated with the general mass. Sometimes the growth is slow ; sometimes, and more frequently, rapid. In all cases, bulk is temporarily increased by mental excitement, muscular exertion, and whatever suddenly and much excites the circulation. The tumour having become superficial by involvement of the skin, ulceration is likely to occur ; and hemorrhage follows, profuse, and not easily restrained ; demanding active interference, otherwise, by repetition or continuance, it may exhaust the patient. Or the ulceration may have a salutary result ; if surrounded and preceded by fibrinous exudation, the vascular structure may be consolidated, no bleeding taking place, even from an acute and wide ulcer ; and this consolidation advancing as the ulcer spreads, so as invariably to precede and surround the breach, the adventitious structure may be altogether got rid of, partly by obliteration, partly by ulcerative loss of substance. Sometimes hemorrhage is vicarious in the female adult, taking the place of the menstrual discharge ; the tumour becomes tense and full at the return of each period ; a small fissure, or sore, forms in the skin, and from this the blood slowly distils ; such bleeding is seldom dangerous, or even excessive, and is not to be suddenly arrested, without means having been duly taken to secure return of the normal discharge.

The third form of the affection, or true erectile tumour, is obviously not a mere deformity, but a disease of much importance, tending by rapid growth to bring life into imminent peril. The question of treatment therefore is not devoid of interest. It may be conducted on three different principles. 1. By removal of the morbid structure. Excision, so applicable to tumours in general, is inexpedient ; the extent and

activity of the component vascular tissue renders that mode of removal in the highest degree perilous. To cut into the texture of such a tumour, when large and pulsating, would be madness; the gush of blood might prove almost instantly fatal. To cut even wide of the diseased texture, is not always a matter of safety; unless the knife move cautiously, and the forceps and ligature follow nimbly after, the loss of blood will still be dangerous. The mode of removal by excision, therefore, must be limited to those tumours which are small—not larger than a prune—of no unusual activity, not fed by large and numerous arterial trunks, so situated as to admit of the incisions being made wide of the diseased structure, and also in a locality favourable for the use of the ordinary means of restraining hemorrhage. In all other cases, the ligature is preferable. A needle is passed beneath the mass, carrying a stout ligature; the needle is withdrawn, and the ligature left; its noose having been cut, each portion is tied separately on either aspect, so as to include the whole of the morbid tissue; pulling with as tight a strain as the ligature will bear, in order at once to kill the included part, and save both time and pain. If the swelling be circumscribed and prominent, this mode of deligation will be found very suitable; if diffuse, a second needle and ligature may be passed at right angles to the first, and managed in a similar way; the tumour then being secured by four nooses instead of two. Or, if too flat and spread for even this, two hare-lip pins are passed beneath the base, at right angles to each other, and left permanently there, each extremity of each needle protruding somewhat beyond the integument; then a stout ligature is thrown around the whole mass and drawn tightly, secured beneath the protruding ends of the needles; in this way, the noose is made to embrace the whole of the diseased formation. In whichever way deligation is employed, it is often necessary, in the case of large tumours, to make a fresh application within a few days after the first, in order to expedite the sphacelation. But in all cases in which the integument is uninvolved, the use of knife and ligature may be happily combined; the former being employed, in the first place, to reflect the integument in flaps, and thus to expose the diseased structure naked and defenceless to the needle and ligature. In this way, strangulation is effected much more effectually; the part is killed at once, and soon sloughs away. The flaps are then reponed; and, in consequence, not only is the process of cure by granulation abbreviated, but loss of substance saved, and consequently less cicatrix and deformity occasioned:—a point of some considerable importance, when it is remembered that the ordinary sites of the tumour are on the head, face, and neck. Sometimes the morbid structure is so diffuse, as to render inclusion of the whole, by one deligation, impracticable. In that case, it may be taken away in detachments; the operation being repeated at different parts, successively.

2. By diminution of the arterial supply. When the tumour is so situated as to be remedially inaccessible, either by knife or ligature, this mode of treatment is advisable. When, for example, erectile tumour occupies the cavity of the orbit, we are warranted in performing deligation of the common carotid; experience has spoken in favour of the

practice. The circulation is weakened in the tumour, not arrested ; coagulation may partially occur, causing obliteration ; but it is more probable, that the dilated arteries merely recover their normal calibre, remaining pervious. Immediately after the main artery's deligation, they are comparatively empty, and remain so until the collateral circulation is fully established ; and, their tone never having been lost, they naturally contract, and accommodate themselves to their reduced contents. By the time circulation is fully restored, they have become confirmed in their diminished bulk ; and, the heart's impulse being still modified, re-distention does not occur. This salutary result is greatly favoured by free blood-letting, after the operation ; a practice in two points of view highly expedient ; first, because protective of internal organs from congestion, as formerly explained ; second, by maintaining a diminished circulation in the part, as well as in the whole system, favourable to the desired salutary change. At the same time, the other means, formerly spoken of as conducive to languor of the circulation, will not be neglected.

When the arteries which feed the tumour are numerous, deligation of the principal trunk at some distance is not likely to prove effectual. In such circumstances, it has been proposed to surround the tumour by incision, tying each vessel as it springs, so as to cut off the vascular supply ; inducing flaccidity and collapse of the tumour ; and continued pressure, subsequently, probably causing obliteration of the morbid tissue. The practice has been adopted with partial success ; but in all situations where deligation of the tumour is available, this is much to be preferred.

3. By effecting change of structure ; consolidating the contents of the vessels, and obliterating their canals ; converting, by fibrinous exudation, the loose tubular texture, into a dense and compact mass. This may be effected in various ways. Pressure may be applied with sufficient intensity. Sloughing may occur ; but if this be preceded and accompanied by dense plastic exudation, no harm will result. If the growth be small and superficial, a fine needle may be passed beneath, and a roll of ligature applied above, as in twisted sutures ; the needle being withdrawn, so soon as the inflammatory process seems to be sufficiently excited by the compression. Formations capable of being so treated are not unfrequently found on the bridge of the nose, especially in the female. The *potassa fusa* may be applied ; not intensely, so as to produce a large eschar ; for, on its separation, there would be a likelihood of hemorrhage ; but lightly, so as to induce ulceration—imitating the form of spontaneous cure which sometimes occurs thereby. A puncture having been made through the skin with a lancet, a hot needle, or one dipped in any caustic, may be introduced, and moved in various directions through the mass ; the inflammatory process following, accompanied by more or less of the desired plastic deposit. Or, with a like view, some stimulating fluid may be injected through the puncture, by means of a fine syringe, such as Anel's ; this proceeding, however, is not devoid of danger, by the induction of diffuse infiltration, sloughing of the cellular tissue, and grave constitutional disorder ; patients of tender years have perished in consequence. A seton may be passed

through the tumour; the needle small; and the thread large, so as to occlude the aperture completely, and prevent immediate bleeding. It is worn till suppuration is fully established, with plastic exudation, more or less copious, around its track; and, if need be, one or two such may be made to traverse the tumour in various directions. Vaccination may be performed on the part. A child having been born with such a growth, the vaccine virus, at the ordinary time, may be inserted beneath the skin at various points of the little tumour, instead of at the usual site; and it is quite possible that the inflammatory process, which attends the formation of the vesicle, may have an obliterative effect on the morbid tissue. All such minor modes of treatment, however, as have been considered under the third head, are liable to fail; rendering subsequent recourse to more stringent measures necessary. And seeing, as has been well observed by Mr. Liston, that one mode of operation is usually as formidable in the eyes of the patient and friends as another, it is better at once to have recourse to that from which failure is least likely to result.

4. By amputation. If the diseased texture involve the greater part of a finger or toe, as sometimes happens, it is well at once to amputate the affected part; due arrangements having been made to meet the unusual amount of hemorrhage which is likely to occur.

The second form of vascular tumour consisting chiefly of enlarged and tortuous veins, is most conveniently treated by deligation, in general; when small, and on an external part, it may however be excised.

The first form of growth, or *nævus*, may be excised safely enough, if the deformity be deemed by the patient a sufficient warrant for so severe a measure. In the majority of cases, it will be better to content ourselves with inducing ulceration. The potass, needle, and vaccination, though unsuited for the true erectile formation, will here be found very efficient. Not unfrequently, what seems to be but a *nævus* in the infant, grows into an erectile tumour during childhood or adolescence.

Another form of *nævus* consists merely of discolouration, dependent on a perverted condition of the pigment. Vesication may be tried, by the nitrate of silver or otherwise; but, in truth, the affection is so trivial as scarcely to call for interference.

Arterial Varix.

By this term is meant a dilated and tortuous condition of an artery, analogous to what is so common in the veins. We sometimes see an approach to this in a superficial vessel; as in the branches of the temporal. But it is a rare affection. If troublesome, relief will probably be obtained from gentle and uniform support, by bandaging.

CHAPTER XI.

AFFECTIONS OF VEINS.

Phlebitis.

Phlebitis.—By this term is understood the inflammatory process, in its various grades, occurring in the venous tissue; an affection infinitely more common than arteritis. Degeneration of the coats, on the other hand, so frequent in arteries, is in the veins comparatively rare. Phlebitis may be idiopathic or traumatic; the result of injury, or unconnected with any assignable external cause. The same circumstances which favour the accession of erysipelas, seem also to predispose to this disease.

Coats and contents are altered by the morbid process. In the minor grades, the latter assume the solid form, and become incorporated with the coats, which are thickened and rendered opaque by fibrinous deposit. A higher grade of action gives suppuration. The pus may be deposited between the thickened coats, forming abscess there. Or it may be secreted from the free surface of the internal coat, as more frequently happens; then either accumulating in the form of abscess, the canal being obstructed by consolidation above and below; or mingling at once with the passing blood, the vein remaining pervious. A more chronic form of the higher grade, limited to one part of the vessel, causes ulceration and hemorrhage; a result not so common as in the arterial tissue, and more frequently making its approach from without than from within. Suppuration, on the other hand, rare in arteries, is too common in veins. Under a still higher amount of action, the tissue perishes by gangrene; hemorrhage ensuing or not, according as the canal has or has not been obstructed by plastic exudation.

A striking peculiarity of the internal coat of veins, is its great susceptibility of the inflammatory process; and the tendency of this, when it has occurred, to extend rapidly and far by continuity. At one time, it was supposed that, in consequence of this, the fatal tendency of the more aggravated cases could be explained; the morbid action having reached the right side of the heart, and arrested its all-important function. But experience has shown that such is not the case. In the great majority of examples, the action has ceased before the heart has been reached; usually terminating abruptly, where a cross current flows in upon the main, through a collateral branch. How the cross branch should produce this arrest, it is not easy to explain; but that it has this effect, is undoubted. The extent of femoral phlebitis, for example, is likely to be abruptly limited where the saphena joins; humeral phlebitis terminates where the cephalic enters.

I. *Fibrinous Phlebitis.*—This is the minor grade of action, giving no higher result than fibrinous exudation. There is pain in the affected

part, increased by pressure ; and the vein is felt thickened and hard ; the integuments are involved, presenting a broad, red streak, immediately above the affected vein, and corresponding in extent. Sometimes erysipelas is co-existent ; then the peculiar stripe becomes merged in the general redness. The system labours under a febrile accession, slight, and of the inflammatory type. The venous contents coagulate. The coats become thickened by fibrinous exudation ; plasma is also secreted plentifully by the internal coat, and, mingling with the fibrin of the blood, contributes towards the incorporation of the latter with the venous tissue, consolidating the whole into one impervious mass. The vessel then feels a firm, hard, and painful cord. The limb—the lower limbs are the ordinary site of this disease—beneath the affected part, is more or less swollen by passive congestion, the result of the venous obstruction ; and the cellular tissue around the inflaming vein is also somewhat œdematous. On the action subsiding, the cord begins to decrease ; deposit abates, and absorption begins. Then, one of two events may occur. Either absorption may remove the coagulum, as yet but imperfectly incorporated with the plasma, and the vessel's tube becomes pervious as before ; a thickening of the coats being the only remainder of the morbid results. This is much more likely to occur than in an obstructed artery ; for experience proves that a vein, hard and obviously impervious for weeks, may again open up its cavity, and carry blood as before :—an event rather too common after the treatment of varix, with a view to a radical cure. Or, the obstruction continues ; the coats and solid contents remain completely incorporated ; both dwindle down by uniform absorption ; the vessel's tube is obliterated ; and itself degenerates into the semblance of a mere thread.

The ordinary antiphlogistics, moderately applied, suffice for the treatment of this form of the disease. Rest, fomentation, low diet, purging, and antimony. Leeches are not often demanded ; when deemed necessary, they are applied near the affected part, but not on the stripe of red integument, otherwise erysipelas might ensue. If it be an object to procure an open state of the vein, mercurial applications may be used over the affected part, after subsidence of the acute stage.

II. *Suppurative Phlebitis*.—This is usually of traumatic origin. It may occur in one of two forms ; Limited or Diffuse ; the former comparatively safe, so long as the character of limitation is retained ; the latter invariably fraught with the utmost danger. 1. *Limited*.—The diseased action commencing with a minor grade, the same results ensue as in the fibrinous phlebitis ; coats are thickened ; the contents are solidified ; circulation is arrested at that point. Then suppuration takes place ; and the pus, poured out by the lining membrane, mingles with the coagulum, which becomes broken up. The venous coats yield to the accumulating fluid ; and bulging outwards, produce a fluctuating tumour ; the integuments become more red, and swollen ; in short, the ordinary characters of acute abscess are presented. Above and below the suppurated part of the vein, the incorporation of coats with contents is not disturbed ; dykes, composed of plasma, intermingled with coagulum, remain ; presenting a salutary barrier to the irruption of pus into the open portion of the vessel, and thence into the general circula-

tion. The constitutional symptoms are of the sthenic inflammatory type—more marked than in the simple fibrinous form.

2. *Diffuse*.—In this form there are no protective dykes; all has given way before the acute suppuration. There is no bulging tumour; no indication of matter accumulating, and approaching the surface. The circulation was only temporarily arrested; during the brief fibrinous change. It is again fully restored; and pus, secreted largely by the inner membrane, is mingled directly with the blood, and carried at once into the general circulation; producing the most direful consequences, as if a poison. Constitutional symptoms, preceded by rigors, set in of the most urgent kind; typhoid, and tending to rapid and fatal prostration. Not unfrequently, superficial abscesses form over the affected vein; sometimes the cellular tissue there is the seat of diffuse infiltration. The disease may have been from the first of this kind; then the symptoms, too, from the very commencement, are urgent. Or, the limited form may have degenerated into the diffuse; the protective dykes having stood for a time, but at length giving way before the disruptive action. In the latter circumstances, the occurrence of the change from limited to diffuse is marked; locally, by dispersion of the soft swelling; constitutionally, by intense shiverings, followed immediately by the formidable constitutional aggravation. In whichever way the diffuse form supervene, in the greater number of cases it proves fatal; not by extension to the heart, as has been already stated, but by the typhoid symptoms consequent, and doubtless dependent on, the admixture of pus directly with the circulating blood in large quantity. The fatal issue is usually accelerated by the formation of what are termed *purulent dépôts*. The most frequent site of these is in the lungs; they are also found in the liver, sometimes in the spleen, and sometimes in the larger articulations. They seem to be formed with great rapidity; within a few hours. Yet they are no exception to the general rule, of inflammation being essential to suppuration. The inflammation is present, and precedes; differing from its ordinary character, only in the greater rapidity with which its suppurative crisis is attained. Neither are they the result of mere conveyancing, as some have supposed. The pus of the suppurated vein is not carried to the heart, from thence to the lungs, and, when there, simply deposited in the parenchyma. The pus is a secretion from the inflamed part; the only difference from an ordinary suppuration being, the rapidity with which the formation of the abscess is completed. The precise nature of the circumstances which lead to this result, is still a matter of uncertainty and dispute; but the following may be considered at least an approximation to the truth. The pus, directly and profusely mixed with the blood, acts as a poison on the frame; and accordingly the circulating system—as it were, by a self-protective effort—endeavours to free itself from this noxious matter by elimination. The natural organ for such elimination is the lungs; and thither the pus globules are sent. Part may be eliminated; the serous portion of the purulent fluid may be wholly extruded; but part of the globules remain, impacted in the pulmonary capillaries. There they prove the exciting cause of an acute inflammatory process; which, occurring in a part and system of low vital power—for by this time the typhoid symptoms have been fully

established—attains rapidly to its suppurative crisis. Purulent formation in the liver may be similarly explained; this organ being most likely to suffer, in the case of phlebitis situate on the lower limb; the lungs, in phlebitis of the upper. Solution of the articular affection is not so easily afforded; unless we, somewhat imaginatively, suppose that the eliminating effort, foiled in the more ordinarily selected parts, seeks the aid of a common secreting surface.

In the treatment, our chief object is to prevent suppuration if possible. Antiphlogistics are plied actively and early. In the robust, a full bleeding may be taken from the arm; in all cases, local depletion must be freely employed. Leeches are used plentifully; in two divisions; one attacking the main seat of the disorder; the other operating on a part of the vein, as yet either entirely free, or involved only in a minor grade of action, and situated on the cardiac aspect of the part chiefly affected. Our object is not only to subdue the inflammation already risen; but also to prevent that acute extension to which phlebitis is so prone; at the same time, to insure, so far as we can, that when the action does reach the higher point of the vein, it may be of a subdued form, favourable to consolidation; and that so a dyke may be constructed, whereby suppuration, when it does occur in the part originally seized, may be prevented from admixture with the circulation. Absolute repose is maintained, of the whole body, and more especially of the part. Hot fomentation is diligently used; medicated by a weak solution of the acetate of lead with opium. Should we succeed thus, in either preventing suppuration altogether, or in confining it to the limited form, the event is fortunate; the constitutional disturbance is slight, life is not perilled, the local change can be easily recovered from. Should we fail, however, as is not unlikely; should suppuration not only have occurred, but be plainly of the diffuse form—then blind adherence to the antiphlogistic treatment is but infatuation. Typhoid symptoms are already setting in; the system already has begun to yield; the whole plan of treatment must be at once changed; prostrating remedies being desisted from, and stimulants held in readiness for free yet cautious and skilful use. Our only duty then is to support the system, by prudent stimulation; affording a chance—by affording time—for elimination of the noxious admixture, and consequent rallying of the system from its poisonous effects.

Be it understood, however, that the above system of treatment is not applicable to all cases of the disease; but only to those which are under charge from the commencement; and in which the preliminary symptoms are more or less of the sthenic type. There are many cases seen for the first time, only when that stage is past; in these, antiphlogistics are never to be thought of. And there are not a few, in which from the very commencement the symptoms are altogether asthenic, evincing rather the irritative than the inflammatory type, in which the more active antiphlogistics, especially loss of blood, even at the very outset, must be used sparingly, if at all. Should erysipelas co-exist, it is to be regarded as the minor evil, and treated accordingly. It is, however, an unfortunate and serious complication, and unfavourably qualifies the prognosis.

Blisters, applied in narrow strips over the inflamed vein, are highly

extolled by some, and reprobated by others. In this country, the preponderating opinion seems not in their favour; they are not unlikely to fail in arresting the phlebitis, while they succeed in inducing erysipelas. If used at all, it must be with much circumspection, and only subsequently to local depletion. In fibrinous phlebitis they are more suitable; should chronic action prove obstinate. They may have a favourable effect in removing such action; at the same time favouring absorption of the coagulum and deposit—should that be an object of desire.

In the limited suppuration of a vein, the same treatment is to be followed as in ordinary acute abscess. A free and early incision is made, followed by fomentation, poultice, and rest. No unwonted hemorrhage occurs, the venous canal being obstructed at each extremity of the abscess; the cavity granulates, and closes in the ordinary way. Should incision be delayed, there is much danger of the protective dykes yielding before the pressure of the accumulating pus, and of the case being thus unfortunately converted from the limited form into the diffuse; from a comparatively trifling affection, into one which most frequently terminates in death.

Seeing the importance of the fibrinous dykes, it has been proposed artificially to induce their formation, in urgent cases of phlebitis; by applying the potass, or other caustic, to a portion of vein on the cardiac aspect of the affected part. The attempt has failed, however, as might have been expected; the phlebitis induced proving not obliterative, but suppurative; the original disease not becoming limited, but extended and still diffuse.

Such being the dangers of phlebitis, it surely follows that the exciting causes of that disease should be most carefully avoided; in other words, that the surgeon should shun interference with the venous tissue, in his operations, as much as possible; and that, more especially, deligation should be withheld. A certain amount of true inflammation must follow, to throw off the noose; and it is not unlikely to spread, at once establishing the worst form of the disease. Surgical opinion, no doubt, is divided upon this subject. One class of practitioners have no dread of tying veins, and do not hesitate to do so, when their hemorrhage is at all troublesome. Another, possessed of a salutary fear of phlebitis, withhold the ligature, unless under circumstances of the most extreme urgency; and at all times are chary of disturbing the larger veins, by knife, finger, or forceps. In the latter class I would beg to be included. Surely, if we err at all; it is well to do so on the side of safety.

It should also be borne in mind, that the air of hospitals predisposes strongly to the occurrence of phlebitis; and that, therefore, in our public practice, we should be if possible still more careful of interference with the venous tissue, than in ordinary circumstances.

Varix.

By this term is understood an enlarged, elongated, and tortuous condition of the veins of a part, usually superficial; with comparative

languor of their circulation. The valves, on account of the dilated calibre, have become inoperative; and consequently oven muscular exertion cannot restore the usual celerity and steadiness of onward flow. The dilatation is not uniform but bulging; and is usually greatest at the site of the inefficient valves. The coats are not attenuated, but on the contrary thick and rigid; not improbably they have undergone a chronic form of phlebitis, of a very minor grade, analogous to that chronic arteritis, which induces a degeneration of the arterial tissue favourable to aneurism. This supposition is strengthened by the circumstance, that the disease seldom occurs till after the adult age. The limb, beneath, tends to œdema; and its vital power is more or less impaired. It is prone to assume the inflammatory process on its surface; and this tends to induce ulceration. The ulcer, spreading, may perforate the vein; and troublesome hemorrhage ensues. Pain and a sensation of weight usually attend, independently of ulceration; sometimes neuralgic pains occur in the part affected; and its function is more or less impaired.

The cause of varix is, whatever obstructs the venous return; more especially direct pressure on the venous trunk above, as by distended rectum, enlarged uterus, or any other tumour. The parts of the venous system most frequently affected, are; the superficial veins of the lower limbs, and of the abdominal parietes; the veins of the spermatic chord; and the lower hemorrhoidal veins, at the verge of the anus. Sometimes varix occurs in the upper extremities, in consequence of sudden and violent muscular exertion; it may be that the venous coats have partially given way, and that obstruction has followed at the yielded part.

Treatment.—A spontaneous cure may result, by the accession of fibrinous phlebitis in the affected veins; their canals becoming consolidated, constituting a hard indolent swelling; which, by absorption, ultimately disappears. The blood finds another outlet, by a collateral route. Like the spontaneous cure of aneurism, however, this is not sufficiently frequent, to allow of its being trusted to in practice. Cure must be sought, not merely hoped for. It may be palliative or radical.

1. *Palliative.*—Bearing in mind what was formerly stated regarding the propriety of not unnecessarily interfering with the venous tissue by operation, and also remembering that varix is in most cases rather a deformity and inconvenience than a disease of itself dangerous to life, it will be readily understood how this mode of treatment should be regarded as the more generally applicable. It consists in removal of the cause, and in affording support to the dilated veins. The rectum is emptied, and kept habitually clear, by suitable laxatives; and if other compressing agents are in force, they too must be removed, so far as may lie in our power. In the case of pregnancy, we must patiently wait for the natural relief by parturition. If hepatic derangement be indicated, the suitable remedies must be employed. The erect posture should not be long maintained. And uniform support of the affected part is to be afforded, by bandaging or a laced stocking; tight enough to diminish the venous calibre and volume of blood; not only preventing increase of the disorder, but giving an opportunity for contraction and partial recovery, should tone enough remain; yet slack enough to admit

of motion, and prevent undue constriction of the limb. On account of the latter indication, it is expedient that the compressing agent should be of an elastic material. If the patient do not grudge the leisure and confinement, more active measures may be adopted. Maintaining the recumbent posture, and never omitting to remove the cause, pressure may be applied with more intensity and without chance of interruption; as by the starched bandage, or by encasing the limb in a mould of gypsum. After the perseverance of a week or two, the dressings may be undone, with the hope of finding not a mere temporary alleviation, but perhaps a permanent and effectual cure; partly by obliteration, partly by restoration of the normal calibre and tone.

It is no uncommon thing for life to be brought into peril, or even lost, by means of a simple varix. Suppose, as often happens, that a patient in the lower ranks, much in the erect posture, and following a laborious avocation, has a varix of the leg, with ulcer of the super-imposed integument. Suddenly, the vein may give way, by ulceration; or it may be that a prick of a knife, hatchet, or other tool, makes a wound. Profuse hemorrhage occurs; much blood may be lost in a few minutes; the patient faints; ineffectual means are taken by the by-standers to arrest the bleeding; he recovers; the hemorrhage returns; and, by its repetition, he may be fatally exhausted ere surgical aid arrive. Many lives might be saved, were it more generally known how, in all cases of venous hemorrhage, gentle but accurate and steady pressure of the finger or thumb, on the bleeding point, will effectually restrain the flow.

2. *The Radical Cure.*—This depends on effecting obliteration of the affected veins. They may be directly cut into, and compressed; supuration of the wound necessarily follows; and, if it heal kindly by granulation, obliteration of the venous cavities will doubtless be obtained. Or a portion of the vein may be cut out; and pressure may be applied to each cut extremity, so as to restrain bleeding, and favour fibrinous occlusion. Or the vein may be cut down upon, and encircled by a tightly drawn ligature, as if it were an artery. All these three modes are doubtless perfectly equal to the obtaining of the desired obliterative result; but ample experience has shown, that the inflammatory process seldom ceases, short of the suppurative phlebitis; and that this not unfrequently assumes its worst and most dangerous aspect. Many patients, endeavouring to free themselves from the inconvenience of a mere varix, by such means, have lost their lives by the induction of diffuse suppurative phlebitis. Deligation is obviously inapplicable; a certain amount of suppurative inflammation of the vein must inevitably follow, and is very apt to spread. If incision be attempted at all, it ought not to be direct, but by the oblique and subcutaneous method of puncture; so as, if possible, to avoid true inflammation and suppuration in every part of the track of the wound. Pressure is required afterwards, to restrain the escape of blood and prevent infiltration of the textures. Let not this be severe; a very moderate degree, if applied and maintained with accuracy, is sufficient to arrest venous flow; severity, coming after wound, is certain to induce what we wish to avoid—true inflammation. This method was at one time practised by Brodie, but with indifferent success. Now that the principles of sub-

cutaneous section are better understood, the execution might be more skilful, and the issue more prosperous.

However, modern experience and opinion are decidedly in favour of two other modes of treatment, with the view of obtaining a radical cure; cauterization, and the application of the twisted suture. The most convenient mode of applying caustic, is in the form of what is termed the Vienna paste; equal parts of quick lime and the potassa fusa. An incision is made through the skin, over that part of the vein which we wish to obliterate; and a few minutes are permitted to pass unoccupied, that the capillary oozing of blood may cease. Then, the surrounding textures having been protected by a piece of lint, with an aperture in its centre—the aperture corresponding to the exposed part of the vein—a portion of the paste is applied in contact with the venous tissue, and there retained; either permanently, or only for a time, according to the size of the portion applied, and the extent to which we wish to make the eschar. The object is to produce a complete slough of the venous coats, with a surrounding areola of sthenic inflammatory process, giving fibrinous exudation; whereby the venous canal may be obstructed permanently, for some distance above and below the cauterized point; then the suppuration and ulceration, necessary for detachment of the slough, are not likely to extend beyond the mere vicinity of the dead part. This cauterization may be employed in two ways. It may be applied to a sound part of the great venous trunk, above the varicose branches; to the saphena in the thigh, for example, in the case of varix of the leg; pressure being at the same time used to the dilated veins. The effect of obstruction above is expected to be, that the blood will seek another channel, collateral, or in a deeper plane; and that consequently the affected veins, much disburdened, and now comparatively idle conduits, may have an opportunity either of recovering their calibre and tone, or of being obliterated by consolidation. Or the caustic may be applied to the dilated veins themselves, at various points, so as to ensure obliteration. For some days before the caustic's use, the patient should maintain recumbency, and otherwise undergo the same preparatory treatment as for the operation for aneurism; during the whole progress of the cure, recumbency, antiphlogistic regimen, and absence of all excitement, must be observed; and, at the time of the slough's separation, the precautions should be doubly vigilant. At this period, were the patient to get out of bed and walk about, or indulge imprudently in diet, hemorrhage—great, and perhaps fatal—might possibly ensue. And further, that being the period of inflammation and ulceration of the venous coats, for detachment of the slough, such imprudence might very probably lead to extension of the phlebitis; a greater danger than even that by loss of blood. It is also to be remembered that the caustic sores may prove indolent and slow to heal; perhaps becoming a source of greater inconvenience than the original malady, on account of which they have been incurred.

The twisted suture is applied directly to the affected vein, in the following manner; and is generally preferred, as the simplest and safest mode of treatment. A needle, such as used for hare-lip, is passed be-

neath the vein ; and round it a silk or thread ligature is twisted, so as to completely obstruct the venous canal at that point, and compress the coats with some power against the needle. This application is permitted to remain undisturbed for some days. Should much pain, swelling, and redness occur, then the needle is withdrawn ; the vascular excitement is sufficient for occlusion ; it would be imprudent to seek a higher grade by continuance of the exciting cause. If, however, no uneasiness be complained of, beyond what is ordinary and desirable, the needle may be permitted to remain undisturbed, until it becomes voluntarily detached by ulceration. For, in those cases in which the application has been but temporary, experience has shown that renewed circulation is liable to occur, at the part supposed to have been obliterated.

Points of suture are applied, in this way, at various parts of the dilated vein, or veins ; so arranged, as to site and number, as most favourably to conduce towards the oblitative result. The same preparatory and attendant treatment is necessary, as for the remedy by cauterization. And let it ever be remembered, that there is not only greater risk from, but greater probability of, over-action ; than an insufficiency. For it is probable that a varicose vein is more prone to acute inflammation, than a vessel previously healthy.

In whatever way the radical cure is attempted, the erect posture, and laborious avocations ought to be very gradually resumed ; and uniform support, by an elastic bandage or laced stocking, should be afforded to the affected parts, for a long time after. Otherwise, return of varix, even in the same vessels, is more than probable. And again, let it be understood that the risk, by phlebitis, attendant on the simplest and best of these methods of radical cure—the last, by suture—is not slight ; and that, therefore, both patient and surgeon should rest contented with the palliative mode of treatment, unless in those cases in which the inconvenience is great, and obstinate and serious ulceration attends, perhaps with hemorrhage.

Entrance of Air into Veins.

This is a casualty of a most alarming nature ; and may occur during operations, implicating section of the larger veins. In wounds of the lower part of the neck, and of the axilla, a venous orifice is apt to become gaping, or “canalized,” during deep inspiration ; and then atmospheric air will enter, in greater or less quantity.

Certain circumstances favour the accident's occurrence. 1. The site of the wound. The lower part of the neck, and upper part of the thorax, are the most dangerous localities. 2. The condition of the venous coats. If thickened and rigid, by chronic deposit, they tend to remain open when cut, like an arterial tube rather than a venous ; a condition most favourable to the air's entrance. 3. The state of the surrounding parts. These may be dense and consolidated, so as not to permit contraction of the venous orifice ; maintaining it widely open, as in section of the hepatic veins. Or, contractions of the surrounding muscles may have a similar canalizing effect. 4. The degree of trac-

tion made upon the vein. The vessel, if loose when cut, is not so apt to gape, as when tightened by pulling; as it often may be, at the time of section, in the extirpation of tumours. 5. The form of wound in the vessel. The vein, if completely severed, is likely to collapse. If cut only partially, and in a transverse direction, while by traction it is tense the aperture cannot choose but gape. 6. Position of the part operated on. If relaxed, collapse of the venous orifice is favoured; if, on the contrary, placed on the stretch, as usually is the case to a greater or less extent, to facilitate dissection, canalization is rendered more likely. 7. The position of the vein in the wound. A large vein punctured, and situated in the angle between two flaps of a wound, is probably made to gape at each opening up of the incision.

Canalization of the vein, combined with deep inspiration, is all that is required; and it is consequently matter of surprise, that the untoward event should not be of more frequent occurrence. The symptoms which denote it, are as follow:—A noise of air, in motion through a narrow space, is heard; sometimes hissing; more frequently of a lapping or gurgling sound. This is immediately followed by a convulsive struggle; often preceded by a sudden exclamation of impending danger or death. A “churning noise is heard in the heart, synchronous with the ventricular systol;” and the hand applied to the chest “perceives at the same time a peculiar bubbling, thrilling, rasping sensation, occasioned by the air and blood being, as it were, whipped together” within the ventricle.* If but a few particles of air have entered, the alarming symptoms pass away, and the patient rallies. If, however, the entrance have been copious, the convulsions continue; syncope occurs, and is permanent. In some cases, death has proved quiet and rapid, as if by simple syncope; no convulsive movements having taken place. For some time after respiration has ceased, the heart continues to beat; it is the ultimum moriens, in this instance. It might be supposed that the air, distending the heart, would clog its action; and that death would begin there. But it is not so. The mode of death would seem to be the following: The blood, becoming mingled with air, assumes a frothy character, in the left ventricle, and thence is sent through the pulmonary artery; but is more or less arrested in the pulmonary capillaries, or terminal branches of the pulmonary artery, in consequence of the right ventricle being unable to overcome the mechanical obstacle presented by air bubbles in these vessels. The quantity of blood transmitted through the lungs, for the systemic circulation, grows less and less; according to the increase of obstruction and arrest in the lung’s capillaries. The supply to the head is inadequate to afford due stimulus to the nervous centre, and syncope results. If circulation be not restored, the syncope continues; the respiratory movements then cease, and life becomes extinct; the heart last failing in its action, from want of its necessary stimulus, the blood.

When operating in the dangerous localities, of the neck and trunk, care should be taken to prevent this accident. The chest and abdomen should be tightly bandaged, previously to the commencement of the

* Edinburgh Medical and Surgical Journal, January, 1844, p. 6, Erichsen.

operation, during its performance, and for some time after its completion; to prevent deep inspiration—the state most favourable for the air's entrance. The larger veins should be avoided as much as possible by the knife; and when cut, of necessity or by accident, means should instantly be adopted to prevent the occurrence of those circumstances which are favourable to canalization. If deep inspiration, and canalization of the cut vein, be both prevented, the patient is safe—at least from this danger.

Air having entered, as indicated by the peculiar noise, and the alarming symptoms which immediately follow, instant and firm pressure is to be made on the venous orifice, or orifices, and accurately maintained, so as to prevent farther ingress. The application of ligature should be avoided if possible; and when there are plenty of assistants, it can never be imperative. Then, our attention is to be directed to prevention of the fatal result. The first indication is, to maintain due exercise of the cerebral functions, by furnishing, if possible, a suitable supply of arterial blood. For this purpose, we must husband the small available systemic circulation; determining it to the head, and leaving the rest of the body for a time but barely supplied. The patient is to be placed recumbent, with the head low, as in ordinary syncope; by compression of the abdominal aorta, and both axillary arteries, the blood is limited in circulation to the upper part of the body; or, if obesity render pressure on the aorta difficult, both femoral arteries are to be compressed. The second indication is, to maintain the action of the heart, by artificial respiration, and friction at the præcordial region; thereby affording time and opportunity for removal of the obstruction in the pulmonic capillaries, and consequent restoration of the normal circulation. Should we thus succeed in averting the immediately fatal result, means must be taken to prevent or moderate the accession of inflammatory affections of the lungs, which are apt to ensue.

Air forcibly injected into a vein, as by insufflation, produces death almost instantaneously. In this case, death commences in the heart, which is distended and paralyzed by the large amount of air forcibly intruded. Such an event is not likely to occur, however, in the human subject.

CHAPTER XII.

HEMORRHAGE.

BLEEDING may proceed from wound of an artery, or of a vein, or of both. We shall first consider the arterial hemorrhage.

Arterial Hemorrhage.

When an artery is cut across, bleeding is instant and rapid; the blood of a florid red colour; and ejected not in a continuous stream, but per saltum. The arterial orifice remaining widely open, by the elasticity of the arterial coats, and the energy of the heart's impulse being unbroken, much blood is lost in a very brief space of time, from a cut artery of any considerable size; and, *cæteris paribus*, the nearer the wound to the centre of the circulation, the more rapid the hemorrhage. In recent wounds, such bleeding is the most prominent and alarming circumstance; the first to claim the attention of the surgeon, with a view to its arrest. The means suitable for this end are termed *hæmostatics*; and are of two kinds; the work of nature; and the work of the surgeon.

NATURAL HÆMOSTATICS.—These, too, are divisible into two classes; temporary and permanent. 1. *The Temporary.* 1. The artery, so soon as severed, *retracts*, in virtue of its elastic nature, within its cellular sheath; leaving the extreme portion of that sheath, which does not retract—being without the same elasticity—vacant, and of rough surface. In that vacant space, coagulation forms; particles of fibrin become entangled and adherent to the rough points of its inner surface; and these constitute, as it were, nuclei on which others aggregate, to form a clot more or less extensive. 2. Also, by virtue of the inherent elasticity of tissue, the cut artery, while it retracts within its sheath, *contracts* upon itself, at the cut point, diminishing its calibre there; a vital action; producing a mechanical and obvious obstacle to profuse flow from the orifice—inasmuch as that orifice, at the moment of incision wide, is in a few seconds diminished to perhaps a half of its first dimensions. The more lax and free the surrounding cellular tissue, the more favourably is the vessel situated for contraction and retraction; and vice versa. 3. More direct obstacles are thrown in the way, however; by *coagulation* of a part of the passing blood. A coagulum forms in the vacant space of the arterial sheath, as already explained; coming ultimately to occupy that space altogether; of a conical shape, its base resting on the cut arterial coats, its apex projecting in a pouting manner from the orifice of the sheath—as may be

seen in the face of every recent wound. If the wound be open and free, there will be no other external clot; but, if otherwise circumstanced, a certain amount of sanguineous infiltration takes place into the surrounding cellular tissue; the blood, so infiltrated, solidifies; and a coagulum results, more or less extensive, by the pressure of which the arterial orifice is farther diminished, and the first formed clot supported in its hæmostatic office. The flow having been thus temporarily obstructed, a third coagulum forms, as after deligation of an artery; slim and twisted; its broad base resting on that of the first clot, at the cut arterial orifice; its slender apex, on a level with the nearest collateral branch. 4. These important changes are contributed to, by the natural result of loss of blood in considerable quantity; a growing *faintness*, and tendency to syncope. The heart's action abating and the general circulation becoming more and more feeble, the contraction of the arterial orifice is favoured, as also the formation of the coagula. In the distal orifice of the cut artery, similar changes occur as in the cardiac; and more readily. The contraction and retraction are greater; and, the blood's impulse being less, coagulation takes place with both greater speed and firmness.

By such means, in wounds of the smaller vessels, Nature is herself equal to the task of arresting the flow for a time. And if the coagula be not disturbed by re-action, permanent occlusion of the cut orifice is effected, in the following way: II. *The Permanent*. From the cut arterial coats, fibrinous exudation takes place copiously, and becomes incorporated with the adjacent portions of coagulum, whose colouring matter disappears by absorption. The plasma, with perhaps a portion of the decolourized fibrin of the clot—though that is a question—becomes organized; the coats cohere by new and living texture; the opening is permanently sealed. At the same time, as after deligation, the surrounding tissues are condensed by infiltrated and organized plasma; whereby the permanent and fibrinous arterial closure is, as it were, supported and maintained. The coagula are now useless; their time and vocation have passed, and in obedience to the general law, they dwindle down and finally disappear by absorption. At a more distant date, the like happens to the fibrinous exudation around, the parts again become loose, and resume their normal texture. The arterial orifice, and its permanently obstructing fibrinous mass, also undergo a similar change. The arterial canal has already contracted, up to the nearest collateral branch; forming a narrow cone, the base of which is at the collateral branch, the apex at the arterial extremity. This cone narrows more and more; ultimately, the coats cohere, and the canal at that part may become wholly obliterated. Absorption continuing, the consolidated part shrinks to a mere thread.

In the process of natural hæmostatics—wonderfully adapted to the end in view—there may be observed a striking similarity to that whereby a broken bone is reunited. First, the effusion of blood, which coagulates; then exudation of plasma, and absorption of the coagulum; organization of the plasma, which is at first bulky and redundant; lastly, absorption of the adventitious structure, and restoration, more or less complete, of the normal state.

In the case of a lacerated artery, the natural hæmostatics are more readily effected. The orifice is more contracted ; becoming, as it were, puckered ; and reducing the flow to a more tiny stream. Also there is greater retraction ; giving greater space in the vacant sheath, and consequently facilitating, as well as extending, coagulation there. The sheath is drawn at its extremity to a point, affording a more decided obstacle to the passage of the blood, and giving the vacant space a more decidedly conical form—favourable to coagulation—than in the cut artery. Further, the arterial coats do not retract together, as after simple division ; but, giving way at different times, have different degrees of retraction. The internal and middle coats give way first, and together ; they retract most, and remain coherent. The external coat affords most resistance, is most extended, and, having at length given way, does not retract to the same extent as the internal and middle. So that the arterial orifice, as represented by the orifice of the inner and middle coats, is, in the case of laceration, doubly protected ; first by a conical space formed by the equally contracted but less retracted external coat ; and secondly, by the ordinary vacant space of the common sheath. In both of these situations, coagulation takes place ; and so, a double barrier is constructed against continuance of the arterial flow. In other respects, the process of occlusion is the same.

When an artery is only partially divided, hæmostatics are accomplished with greater difficulty. Neither contraction nor retraction can occur. The wound tends to remain open ; and, if circulation be active—by reason of the size of the artery, or its propinquity to the heart—there is much fear of a fatal amount of loss, if Nature's efforts be alone trusted to. And yet it is wonderful, under what circumstances a successful issue sometimes does ensue. Cases are well authenticated, in which the aorta, and even the heart itself, have been punctured ; and yet the patients have survived. Syncope having occurred, a coagulum formed in the wound ; on occurrence of reaction the clot was not disturbed ; but, remaining in the gap, became the means of, not only temporarily, but permanently effecting occlusion. In the ordinary circumstances of arterial puncture, the hæmostatics are as follow :—Blood is infiltrated into the textures exterior to the sheath, and also between the sheath and the artery ; in both situations coagulation takes place ; and the pressure of the clots obviously tends to moderate the flow, through the arterial canal, as well as from the arterial wound. By the infiltration also, relative position is altered. At the moment of infliction, the apertures in the sheath and in the artery corresponded ; but, subsequently, the track of the wound becomes oblique ; and the sheath, where entire, comes to overlap the arterial wound, effectually preventing further escape of blood. It is probable, also, that in many cases coagulum forms in the arterial gap itself ; and if the sanguineous flow have been much moderated by pressure from the exterior coagula, as well as by the faintness which loss of blood has induced, it is probable that the obstructing clot may not be loosened or dislodged ; but may remain, until removed by absorption, after consolidation of the breach by organized plasma. The effusion and organization of this plasma, in and around the gap, constitute the permanent hæmostatics, as in the case of complete division. They may be such as merely to close the

aperture, leaving the normal canal pervious; or the exudation may be to such an extent as to occlude the whole tube, and lead to obliteration at that point. The latter is the more frequent occurrence, and is indeed to be preferred; as rendering the occurrence of secondary hemorrhage, and of aneurismal formation, less probable.

The result depends not a little on the form of the wound. If a mere puncture, in the axis of the vessel, exist—there is no gaping, hemorrhage is comparatively slight, and the process of occlusion is easily effected, the tube remaining pervious. If the wound be oblique, gaping is considerable, bleeding copious, occlusion more difficult, and obliteration of the canal probable. The more nearly the incision approaches the transverse direction, the greater the gaping, the hemorrhage, the difficulty of occlusion, and the probability of obliteration. When it is not only transverse, but involves more than half of the vessel's girth, the gaping is great, the bleeding with much difficulty controlled; and ulceration almost always occurs, to sever the undivided portion of the coats; consequently, the permanent hæmostatics are conducted in the same way, and very much under the same circumstances, as if the artery had been at first completely divided.

SURGICAL HÆMOSTATICS.—A most important qualification in the surgeon, called to a case of hemorrhage by wound, is absence of fear or alarm; and this valuable coolness can only be obtained by self-confidence, founded on an intimate knowledge of the means whereby the flow may be arrested, and on a conviction that he is perfectly competent to apply these effectually. His first duty is to expose the wound. Probably it has been covered up by bandages, or napkins, or cloths, by some alarmed and unskilful hand, in the vain hope of so stanching the flow. These must be all removed. His next duty is to expose the bleeding point. The wound will be found filled with coagulum, through which the blood wells out more or less copiously. This must be all dislodged, with the fingers or forceps; and then the cut orifice is seen, sending forth its jet. Then, and then only, can it be dealt with in an effectual manner. A small vessel, with a tiny stream, may be safely left to the natural hæmostatics; but when the calibre is at all considerable, and the jet active, there is no safety but in the employment of the surgical means of arrest. These are various. None are equal to the ligature, skilfully employed, as a general means; but some may often prove auxiliary to this, while others may conveniently supersede it in certain circumstances. We shall consider them in detail.

1. *Pressure.*—This may be employed, when ligature is either unnecessary or inapplicable. For example, when the bleeding comes, not from one or two arteries of considerable size, but from a great number of small arterial twigs, or resembles rather a capillary oozing, ligature need not be applied to each bleeding point; pressure suffices. Or, when hemorrhage proceeds from arterial orifices, imbedded in dense unyielding textures—as in the almost cartilaginous mass of soft parts which invest a necrosed bone, or in the substance of bone itself—deligation, if attempted, would probably fail; here, again, pressure is to be preferred. It must be early, accurate, and steadily maintained. Early, in order to anticipate infiltration of the cellular tissue; by which aneu-

rismal formation might be favoured ; or, at least, by which an obstacle, of greater or less bulk, would be interposed between the arterial wound and the compressing agent. Accurate, because a comparatively slight amount of pressure, applied directly to the bleeding point, suffices to arrest the flow ; while a great amount of pressure, inaccurately applied, may prove ineffectual. And it is a great object to employ no higher degree of pressure than what is barely sufficient, lest untoward consequences ensue ; the limb might be so tightly girded as to threaten gangrene ; or, at all events, a severe pressure, long maintained, is certain to induce suppuration and ulceration of the wound, whence secondary hemorrhage is not unlikely to ensue. Due pressure is applied in the following manner :—The wound, and bleeding point in the wound, having been exposed, as already directed, the finger or thumb is placed accurately on the latter, so as temporarily to arrest the escape of blood ; while an assistant carefully bandages the whole limb from below upwards, so as to afford a uniform degree of support to the whole, and prevent untoward consequences from the concentrated pressure which is about to be applied. The finger or thumb having been cautiously removed, a small, firm, dossil of lint—not larger than the finger's end—supplies its place ; laid in immediate contact with the arterial orifice. Over this, another and another—each increased in size—are rapidly applied, till the wound has become filled with this graduated compress ; of a conical form ; the apex in contact with the arterial wound, the base projecting a little beyond the level of the surrounding integument. This accurately fitted compressing agent is then retained in its place, by continuation of the bandage upwards ; and the degree of pressure is regulated, by the tightness with which the roller is drawn. The whole surface of the wound is compressed somewhat, but the main pressure is concentrated directly on the bleeding point. If the dressing remain dry and unstained by blood from beneath, it is a sign that the application is effectual ; and it is left undisturbed. If, on the contrary, the blood soon appear, and trickle through, the whole must instantly be undone, and re-applied more carefully ; blood, having oozed through the dressing, must have previously collected on the wound ; coagulation has taken place there ; and the interposition of a clot, between the compress and bleeding point, renders pressure inaccurate, and consequently, ineffectual. The dressing is retained for three or four days, unmoved and unabated ; then the apparatus is undone, and re-applied more lightly than before ; and, having been retained for several days more, it may then be wholly discontinued. In re-application, it is well not to interfere with the deep part of the compress, if dry, accurately applied, and adherent. And, after pressure has been wholly removed, the deep part of the compress should not be taken out by forceps or fingers, but should be permitted to come away, loosened by the discharge ; for the less the advancing occlusion by fibrinous exudation is disturbed, the better. The pressure may be likened to Nature's temporary hæmostatics ; restraining the flow, temporarily, by the intervention of mechanical obstacles ; till time and opportunity are afforded, sufficient for the permanent occlusion by organized plasma.

In the case of slight wound of a large vessel, pressure may be so re-

gulated as to effect occlusion of the arterial wound only, leaving the arterial tube pervious as before. But, as formerly stated, this is not only an unnecessary but a dangerous refinement in surgery; not unlikely to favour aneurismal formation. It is easier, safer, and altogether more advisable, to apply such an amount of pressure as shall obliterate the arterial canal at that point, not only temporarily but for ever.

Pressure may be applied indirectly and temporarily; with the view of restraining hemorrhage, until the necessary means have been adopted for securing the bleeding points. Thus, in copious hemorrhage from a wound of the leg, it is advisable to compress the femoral, until the direct hemostatics have been completed. For this purpose, the fingers or thumb of an assistant can be employed; and these are the best compressing agents, when steady and exact. Or, a mechanical substitute, acting in a similar way, may be used; consisting of a strong steel spring, furnished with a pad at either extremity; one of which pads is applied accurately over the arterial trunk, the other resting on the opposite part of the limb. By either of these methods, the pressure is confined to two points, and the evil consequences of uniform constriction of the whole limb are avoided. The mechanical spring is inferior to the living fingers in one important particular; it is more apt to slip, and thus to endanger considerable loss of blood ere re-adjustment can be effected. It has one equally obvious advantage; however tedious the manipulations of the wound may prove, requiring long continuance of the temporary pressure above, it is not liable to become unsteady and wavering from cramp or fatigue. But the most common expedient for indirectly and temporarily restraining hemorrhage, is the *Tourniquet*; a circular band, whereby the whole circumference of the limb is tightly constricted; tightened by a screw, which at the same time forces down a compress or pad upon the vessel's track with a special intensity of compressing force. The objections to this instrument are, the pain which the tight constriction of the limb cannot fail to produce, and the favouring of venous hemorrhage which must necessarily result from so complete an obstruction of the venous return. Its advantages are, that when applied, it is not likely to become displaced; and, with it, we are independent of an assistant. The most convenient form of the instrument is that invented by Dr. Malan of Geneva; the screw flat, and double, admitting of the principal pressure being more rapidly and powerfully applied; when adjusted, less in the way of the operator, and consequently less apt to be displaced by lateral force accidentally applied; also, not likely to be displaced by the voluntary efforts of the patient, to whom the pressure of any tourniquet often proves quite intolerable.

When hemorrhage has occurred into an internal cavity or canal, whose parietes are not very extensile, the best mechanical means of arresting the flow, is, to convert the blood itself into the compressing agent. In profuse bleeding from the uterus, for example, we obstruct the vagina; in epistaxis, we plug the nares. The blood cannot escape; and, as it accumulates, it exerts pressure on its source.

2. *Position* is important; so regulated as to retard and oppose the arterial supply of the wounded part. The sanguineous flow being thus

moderated, natural hæmostatics are plainly favoured. In wound of the hand or foot, for example, the injured part should be placed in as elevated a position as circumstances will permit, and so retained till hemorrhage has ceased.

3. *Cold*.—Cold is useful, not by superseding Nature's temporary hæmostatics, as does pressure, but by assisting them. It is applicable to the slighter cases; to oozing, rather than to ejection of blood. Opening up the wound, and exposure to the atmospheric air, may often suffice. Or, this failing, a greater degree of cold is applied by means of lint, moistened in water; taking care that the cold is continuously maintained, either by the system of constant irrigation, or by very frequent wetting of the lint; at the same time the part is left freely exposed, uncovered except by the wetted lint. This mode of treatment is in two ways useful; first, by tending to arrest hemorrhage; second, by tending to avert inflammation, and so to favour adhesion. The mode whereby the former indication is fulfilled, is, by the cold repelling general circulation from that part of the surface to which it is applied, at the same time constricting the vessels; also, by increasing contraction of the cut arterial orifices, and favouring the formation of coagula.

4. *Styptics*.—These also are auxiliary to the natural hæmostatics. Cold water may be ranked among the number; the simplest, and also the most generally applicable. There are others, however, which have a more powerfully constricting effect on the arterial tissue; as turpentine, creasote, solutions of iron, alum, zinc, mercury, &c. Also, some substances, as agaric, cobwebs, felt of a hat, &c., adhere to the surface, at the same time entangling the blood and favouring the formation of coagulum; and thus mechanically tend to arrest the bleeding. Whatever be their action, styptics may be generally rated as applicable only to the slighter forms of hemorrhage; more especially to cutaneous or mucous oozing; and even then, not until the more ordinary and suitable means—cold, exposure to atmospheric influence, and attention to position, have been tried, ineffectually. For, styptics being usually more or less of a stimulant nature, are, in their ultimate effects, unfavourable to the healing process; inducing inflammation and suppuration; preventing adhesion.

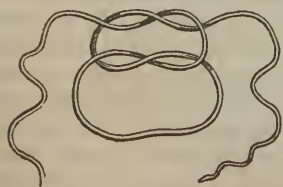
5. *Escharotics*.—These may be actual or potential. Of the latter class, the *nitrate of silver* is generally employed. It has an astringent effect on the arterial tissue, like the more simple styptics; and besides, induces an immediate coagulation of the sanguineous and other fluids with which it comes in contact, on the surface to which it is applied. This coagulum, further, is adherent to the texture beneath; and thus the remedy combines the two modes of action which styptics were said to possess; constricting the vascular orifices, and at the same time covering them with an adherent mechanical obstruction. This is an admirable application in the minor cases of obstinate bleeding; especially in the mucous and cutaneous surfaces. Often it may be trusted to alone in such cases. In others, of a more serious nature, it forms an excellent auxiliary to pressure. There are some cases of bleeding, partly arterial, partly by oozing, in which it is impossible otherwise to

have the compress placed—dry and firm—in immediate contact with the bleeding points; and, as fully stated previously, an inaccurate compress is likely to prove ineffectual. In such a case, the nitrate of silver is first applied to the part; not so as to have a truly escharotic effect, killing a portion of texture, which must afterwards be detached; but simply so as to produce the hæmostatic result formerly described. The bleeding is stanchd for a time; it may be but for a moment; but even that short space of time is of much value, enabling us to apply the dossil directly and accurately to the part; without interposition of blood, either fluid or coagulated. The coagulum, made by the nitrate of silver, is but a thin film, in no way opposed to accuracy of pressure. *The actual cautery*, is a more severe remedy, to be reserved for more urgent cases; those examples of serious bleeding, for whose arrest other means are deemed inapplicable, or in which other means have been already tried, and have failed. As it sears the surface, the vascular orifices become shrunk, shrivelled, and charred; and this effect itself is powerfully hæmostatic; the shrivelling being such as to obstruct the canal. But besides, all the textures of the burnt part are converted into a dead eschar, in thickness and extent proportioned to the intensity of the application. This eschar is found to consist, not only in a killing, but in a condensation or contraction of the previously living and open texture; a contraction so great as to shut the apertures previously existing, and render the mass impervious to blood. This mass adheres to the living textures, around and beneath, until detached by the ordinary process of ulceration. So long as adherent, it mechanically restrains the flow of blood; when loosened, it is probable that the ordinarily concomitant and antecedent fibrinous exudation has sealed the vascular orifices, and permanently arrested hemorrhage. The formation and adhesion of the eschar may be likened to Nature's temporary hæmostatics; the fibrinous exudation which precedes, accompanies, and follows detachment, to the permanent. If such fibrinous exudation be wanting and imperfect, the arrest by cautery will be but temporary; sometimes such is the case; therefore, at all times, the period of the eschar's separation should be one of anxiety and care. And at this period, if not before, it is well to take additional means for security, by the application of moderate pressure.

6. *Plugging*.—This is sometimes, though rarely, necessary. In amputation, or operations on bones, for example, profuse and troublesome bleeding may take place from a large vessel imbedded in an osseous canal, and refuse to be arrested by the ordinary means; pressure has been tried; ligature is inapplicable; the actual cautery is also inexpedient, for contraction of bone will not follow its use so as to make the eschar impervious. Under such circumstances, it is expedient to fit a piece of wood or cork into the aperture; securing it there, by the requisite degree of pressure. A portion of ligature is attached to the plug, and left pendent from the wound; whereby it is removed, so soon as the period of its usefulness has passed, and when it has become voluntarily loosened by the suppuration which its presence necessarily excites.

7. *Ligature*.—This is of all hæmostatic means the most sure and

satisfactory ; and is not to be superseded, or omitted, for light reasons, in any case of considerable hemorrhage from arterial wound. The effects of a firm round ligature, duly applied, have been already considered ; it now only remains that the mode of use be explained. The arterial orifice is first laid hold of, and pulled outwards from the surrounding textures, in order that the ligature's noose may embrace it, and it alone. For this purpose, a sharp hook, termed *tenaculum*, may be employed ; but forceps are more convenient, and usually preferred. They may be such as used ordinarily in dissection, not too sharp in their points, and with their prehensile surfaces accurately adjusted to each other. Or the spring-artery-forceps, with hooked points, may be used ; and in most cases they are preferable. First, because maintaining a secure hold of the vessel ; even when left to themselves, independently of the hand of the surgeon ; and so, in the case of scarcity of assistance, admitting of the bleeding orifices being more rapidly secured. Secondly, because it is very difficult, if not impossible for the assistant, who secures the noose, to include the extremity of the instrument instead of that of the vessel—a casualty not unlikely to occur, with the ordinary forceps, among inexperienced fingers, or even with much expertness in a deep and narrow wound. Especial care is taken that nothing but the arterial tissue is included in the noose ; and, to this end, the surrounding textures are pushed back by the finger nail, if need be. By the interposition of other tissues than the arterial, at least three dangers are encountered. 1. The inner coat is not divided ; does not resile from the bight of the ligature, and so become favourably situated for adhesion ; but remains in its embrace, and must slough, inflame, and ulcerate. 2. Nerve or vein, being usually in close apposition to the artery, is likely to be included ; and the deligation of either is sure to induce results both painful and dangerous. 3. There is a larger extent of slough rendered unavoidable ; for its separation a proportionally great amount of inflammation and ulceration must ensue ; and thus the danger of secondary hemorrhage is increased. On the other hand, if the vessel, by laxity of the surrounding parts, be much protruded in an isolated state, the noose should be applied near the base of such projection, otherwise the vital power necessary for subsequent occlusion might prove deficient. The first noose is drawn tightly ; not with force sufficient to endanger a tearing through of all the tunics ; but so as to ensure the giving way of the internal and middle coats—a



circumstance so essential to adhesion, and consequent permanent occlusion. The second noose is also firmly applied ; and so as to constitute the reef-knot ; one which will neither slip, nor be pushed off by the arterial impulse, so inducing immediate recurrence of the bleeding. In this manner, each vessel is tied ; rapidly, so as to prevent unnecessary loss of blood ; yet not hastily, so as to endanger carelessness and inefficiency of deligation. Each vessel, which is plainly arterial, and plainly bleeding, should be secured. In an extensive wound, there are muscular branches

which seem small and unimportant, after we have just completed the treatment of the larger trunks; the patient is probably by this time faint; and the bleeding from these points may be little more than oozing. Still, experience inculcates the expediency of deligation being extended to these; otherwise, so soon as re-action has been fairly established, the natural hæmostatics are overborne, and copious hemorrhage ensues; what were before mere oozings, are now distinct and active streams, each demanding ligature; and rendering a painful undoing of the wound, for this purpose, absolutely indispensable. To avoid this, such vessels should always be tied at the same time, and in the same way, as the larger trunks. Better apply one or two ligatures even unnecessarily, than encounter the risk of secondary bleeding—perhaps injurious; and of secondary deligation—always troublesome and painful. In reference to this subject, it is well to remember that it is not an ordinary re-action with which we have to do; but one whereby the wonted contents of the obstructed main vessels are thrown upon the small collateral branches, and which, in consequence, are unusually excited to hemorrhage.

When an artery has been cut obliquely, as is likely to happen in amputation by flaps, especial care must be taken that the orifice is well pulled out from the surrounding textures, previously to deligation; otherwise, the noose may be thrown upon the oblique arterial wound, instead of behind it; and the artery, thus left partially open, cannot fail to bleed.

If, in the wound, an artery be not cut across but merely punctured, two ligatures are essential; one above, the other below the punctured part. One ligature, on the cardiac aspect, may arrest the bleeding for a time; but, so soon as the collateral circulation has become fully established, the distal orifice will bleed almost as profusely as did the other. There is no safety but in two. And the same rule holds good in regard to an artery, when cut across, whose distal orifice remains imbedded in living texture. For example, in amputation of the thigh, the femoral artery requires but one ligature; but if a mere wound be made in the thigh, implicating that vessel, both distal and cardiac orifices must be secured; free dilatation of the wound, if necessary for this end, being unhesitatingly performed.

Sometimes an arterial orifice is surrounded by textures so dense, as to render the ordinary use of the ligature impracticable. If pressure fail, or seem unsuitable, we may be compelled to apply the ligature somewhat clumsily, in order to avoid the greater evil of unnecessary loss of blood. A curved suture-needle is passed through the bleeding point; so as to transfix it, and yet include as little as possible of the surrounding parts; and, around its convexity, the ligature is secured. The needle is then either withdrawn, or permitted to remain for a time, according as circumstances may seem to indicate.

When the bleeding points have been all secured, the ligatures then come to be arranged, with a view to dressing of the wound. If this be left open, to suppurate, and heal by granulation, both ends of each ligature are cut away close to the knot; the knot loosens in due time, and passes away with the discharge. If, however, we intend to bring the

wound together, and treat it for adhesion, one half only of the ligature should be cut away, the other being left pendent from the wound; in order that the separation and discharge of the noose, and its enclosed slough, may be watched and made certain. By some, both ends are still cut away; in the belief that adhesion is thus favoured, throughout the line of wound, as doubtless it is; and in the hope that the noose will become encysted, and give no further annoyance—as certainly will not happen. Adhesion under such circumstances is a misfortune. For, the noose and its contained slough are to all intents and purposes foreign matter; as such, their presence will be resented by the surrounding living textures; and, as such, they will be extruded by suppuration. Sooner or later—often after cure has apparently been completed—deep abscess forms around them; painfully and slowly it approaches the surface, and is discharged—with it, its cause, the noose; and not until this latter has been put forth, will the pain and discharge cease. Or, before this, the arterial coats may have been too far encroached on by the pent up collection; they have become ulcerated, perhaps at a part where the canal is yet free; and secondary bleeding ensues.

In all cases of serious wound, whereby important arteries have been implicated, there is risk of secondary hemorrhage. And this may occur at various times, and from different causes. It may supervene within a few hours after the first dressing; so soon as the patient has become hot and comfortable in bed, and re-action has been fully established. A ligature, clumsily applied, may have been pushed off. More probably, some of the oozing vessels, formerly described, have been overlooked, and unwisely spared from deligation. The wound must be undone, the bleeding surface fully exposed, and each vessel now carefully secured. Or, sloughing may attack the wound, and unoccluded vessels thus be opened into; if the slough be but partial, and the opened artery not large, pressure will probably suffice; if the sloughing be general, or the vessel large, the main artery of the limb must be secured, by incision on the cardiac aspect. Or, by ulceration, induced at the time of the ligature's separation, bleeding results; as after deligation on account of aneurism. In this case, little good will follow a tearing open of the half-healed wound, and a search for the open vessel among the infiltrated and changed tissues. Ligature of the main artery is again requisite; combined with moderate pressure on the bleeding part. At the same time, the general means suitable for the restraint of secondary hemorrhage, formerly detailed, are not to be neglected.

8. *Torsion*.—This is an imitation of the means whereby the lower animals, in parturition, by gnawing and twisting the umbilical cord, instinctively arrest its hemorrhage; and an adaptation of the general fact, that torn arteries, more readily and effectually than the cut, undergo the natural hæmostatics. The arterial orifice is pulled outwards, by forceps, to the extent of half an inch or more. The base of this isolated part is then seized by forceps, which hold it securely, and by whose grasp the internal and middle coats are probably divided. While this instrument is steadily held, so placed, the extremity of the vessel is, by means of the excellent forceps, twisted several times upon itself. It is then left pendent in the wound. This method is only applicable to the

second class arteries; the smaller vessels cannot be so treated; the larger cannot be so treated with safety. In every wound, therefore, wherein the three classes of vessels are implicated, some ligatures must at all events be applied; and it is not easy to see what disadvantage can accrue, from deligation being extended to all. Application of a ligature can be effected in fully as short a time as torsion; when applied, it is undoubtedly a more certain hæmostatic. The twisted portion of the vessel must slough and separate; the noose of a ligature is not more truly, or to a greater extent, a foreign body. Torsion, therefore, is never superior to ligature; and it is doubtful whether, under any circumstances, it may be considered equivalent. Its use is expedient only in the case of a second class artery, when from scarcity of assistants, want of apparatus, or other accidental circumstances, deligation is inconvenient. In this country, it is seldom if ever employed.

9. *Nauseants and General Treatment.*—One of Nature's hæmostatics we found to consist in faintness, supervening on loss of blood. This may be imitated by art; ere yet so much blood has flowed as to establish the natural result. The means are valuable in cases of internal hemorrhage, as from mucous surfaces; to which pressure, ligature, and the other more direct hæmostatics are inapplicable. The patient is made sick and faint; so that the blood may circulate more slowly and gently in the wounded part, favouring coagulation. Actual syncope is not wished; for re-action is likely to follow, and by it bleeding may be reinduced. Neither is actual emesis sought; for that includes violent muscular exertion; and is also likely to be followed by re-action; both circumstances favourable to bleeding. Derivative bleeding from the arm has been practised for this purpose; but the same end may be obtained by the exhibition of such simple nauseants as ipecacuanha or antimony, while yet the important fluid is spared within the veins. Rest—including repose of both body and mind—low diet, cool drinks, and the general regimen suitable for moderation of the circulation, will not be neglected.

Syncope.—This, when temporary, is Nature's last resource in cases of severe hemorrhage. By its occurrence, arresting all flow for the time, lives are often saved; opportunity being so afforded for the use of the required surgical means. Unless the bleeding has been satisfactorily met, by treatment of the wound, the condition of faintness is not to be disturbed. When, however, all has been duly overtaken, and syncope still continues; we naturally become anxious that the patient should emerge from that state. The means are simple. The cause of syncope is twofold; deficient supply of arterial blood in the nervous centres, suspending their functions; inadequate stimulus to the heart, retarding its play. Both are to be counteracted. The patient is placed recumbent, and all means taken to leave respiration unimpeded—as by slackening or removing tight articles of dress from the chest. The head is placed rather lower than the rest of the body, so as to favour the flow of blood thereto; it is a very mistaken kindness to prop the head with pillows, and otherwise endeavour to give it the appearance of comfort. The heart still acting feebly, and much blood having been lost it is well to compress the abdominal aorta and axillary arteries, so

as to husband what of the vital fluid remains, and keep it circulating where it is most required ; in the chest and head. By dashing cold water on the face, applying stimuli to the nostrils, and rubbing the chest, respiration is favoured ; and by the full establishment of this, the heart will be forced, as it were, into renewed play. In desperate cases, galvanism may be employed to restore function in both heart and lungs.

Venous Hemorrhage.

Venous blood, as contrasted with arterial, flows in a dull and dark stream ; but, by continuance, not less capable of perilling life by syncope. Pressure is the general and preferable means for its arrest ; along with removal of all obstruction to venous return. In amputation, for example, it sometimes happens, that after the arterial jets have all been secured, dark streams continue to issue somewhat profusely from the venous orifices. Our first care is, to see that all pressure from above has been removed : whether by tourniquet, or by the fingers of an assistant. Such removal often suffices, of itself, to stanch the flow. If not, let pressure be employed ; either directly on the venous orifices, or by approximation and compression of the lips of the wound. After a few minutes, let the pressure be gently removed ; and then, usually, the bleeding will be found to have finally ceased. If not, let a compress of lint be applied to the bleeding point or points ; graduated, secured, and maintained, as if for an artery similarly circumstanced ; only with less intensity of pressure, a comparatively slight amount of this, if direct and accurate, being sufficient to restrain the flow. The venous coats are held in undisturbed contact ; fibrinous exudation takes place from them, and from the surrounding parts ; the plasma becomes organized ; and by it the venous canal is effectually and permanently occluded.

By every means in our power, we ought to avoid deligation of a vein ; the texture is not suited for, and is apt to resent, the use of the ligature. The internal coat is not divided, as in the artery ; but simply puckered together in folds, and so included in the noose. That portion of it must die ; and, being dead, it must be detached. By no other process than by inflammation, giving ulceration, can its detachment be effected. Consequently it is imperative that the internal coat shall become truly inflamed ; suppurative phlebitis of a part must ensue ; we have already seen how prone phlebitis, especially in its higher grade, is to spread ; and, therefore, it need be no matter of surprise to find the very worst form of that formidable disease—the suppurative and spreading—supervening on the application of ligature to a vein. Limited suppurative phlebitis is inevitable : and it is very apt to become spreading and diffuse. It may, and does, happen that no accident ensues ; that the ligature ulcerates its way out ; that fibrinous exudation extends around ; that the vein is permanently occluded ; and that the inflammatory process does not seek either a high grade or an undue extent. Yet undoubtedly the risk is there ; is great ; and should not be unnecessarily incurred. The only circumstances which demand deligation of a vein, are those in which loss of life by loss of blood is otherwise impending.

Such circumstances occur but seldom ; in the great majority of cases of venous bleeding, as already stated, pressure is sufficient, along with removal of obstruction to venous return on the cardiac aspect of the bleeding point.

Puncture of a vein, if the vessel be not very large, or placed near the centre of circulation, closes readily by natural hæmostatics alone. The flow and force of blood on the wound are comparatively slight ; coagulum forms readily, and is not apt to be dislodged. If the puncture be longitudinal, the lips remain in apposition ; and simply cohere by adhesion. If it be oblique or transverse, there is more or less gaping of the wound ; which, however, soon becomes occupied by coagulum ; and this is strengthened, and supported in its place, by clots formed in the external cellular tissue. Fibrinous exudation takes place from the margins of the wound, and becomes incorporated with the clot ; the exudation becomes organized ; and, as it does so, the coagulum disappears by absorption ; ultimately a new membranous expansion is constructed—continuous with, and furnished by the original coats—whereby the chasm is permanently and efficiently closed. The obstructing clot was, as it were, the scaffolding or mould whereon the new structure was formed ; and, when the latter became complete, the former was undone and removed. The external coagulum is also absorbed ; the new membrane becomes incorporated with the ordinary cellular tissue ; and the part in all respects resumes its normal condition. The venous canal may be obstructed, by excess of coagulum and fibrinous exudation, at the wounded point ; but usually it remains pervious and unchanged ; a striking difference from the ordinary result of the corresponding process in the arterial tissue.

Puncture of an artery may, and sometimes does, simply heal in a manner similar to that of a vein ; that is, by an obstructing coagulum, on and in which a reproduction of the coats is effected, while the canal remains free. But the comparative impetuosity of the blood's flow is a fatal obstacle to the general occurrence of such a mode of cure.

* *The Hemorrhagic Diathesis.*

By this term is meant a tendency to bleeding of an uncontrollable kind, from slight breach of surface ; not arterial, by jets ; nor venous, in full stream ; but capillary, by oozing. In the case of an extensive wound, occurring in a patient so affected, the larger arterial branches might be secured as usual by ligature ; the venous orifices might either give no trouble, or become closed by pressure ; yet bleeding would continue from the numberless capillaries ; threatening to end fatally, notwithstanding all hæmostatic means. This peculiar state of system may be either original or acquired ; most frequently it is the former ; and seems to be hereditary, besides ; descending chiefly, not solely, in the male line ; disclosing itself at an early age, and abating as age advances. The state seems often to fluctuate ; a scratch at one time threatening fatal loss of blood, at another scarcely attracting attention ; and in some patients distinct periods of remission and exacerbation may be observed. At the latter periods, the patient is subject to fre-

quent attacks of pain and swelling, with ecchymosis, of the wrists, ankles, and knee-joints, attended with fever; these symptoms continuing generally about a fortnight; and then disappearing, with subsidence of the swelling and removal of the ecchymosis.

The diathesis has many points of resemblance to both the scrofulous and the scorbutic; and, like these, it has its marks of indication. The most prominent are—an obvious delicacy of system; usually a fair complexion; a thin transparency of skin; irritability of the circulation at all times; occasional febrile accessions, as formerly described; tendency to ecchymosis from the slightest cause, as also to hemorrhagic oozings from mucous surfaces; every scratch, even in other respects the most trifling, causing alarm, trouble, and sometimes danger, by continuing to bleed.

The cause would seem to be twofold; a morbid condition of the blood, and also of the capillaries. The blood looks thin and ichorous. It is deficient in the due proportion of fibrin, and in the power of coagulation; more especially it is incapable, even when wholly at rest, of forming a dense and firm coagulum. And, in consequence of such change in the fluid, there ensues an undue tendency to congestion of the capillaries. So that these vessels, when cut, are not only filled with blood incapable of affording the most important hæmostatic means—coagulation; but also have the amount of that fluid greater than in the state of health. Besides, there seems every reason to believe that the solid part of the blood is changed; that the corpuscles are in some way altered; probably broken up, partially dissolved, and otherwise diminished in size; a change which tends both to favour the fluid's escape from the containing vessels, and to oppose its assumption of the solid form. The corpuscles would also seem to be deficient in numbers; the liquor sanguinis is in excess; and, in the latter, the serum predominates greatly. The capillaries and minute arterial twigs are also at fault. When examined, the latter seem to be devoid of the middle coat; of a thin and feeble appearance, and unusually capacious. It may be that the middle coat is deficient, as some suppose; but more probably it exists, though in a defective state, and certainly much impaired in contractility and tone. In consequence, the other component parts of the natural hæmostatics, are equally defective as the power of coagulation; the cut vessel contracts and retracts, scarcely if at all; remaining open and unshrunk, passively pouring out its thin contents. Further, the vascular coats are friable, and easily torn; slight bruise produces serious ecchymosis; coughing may induce hæmoptysis; a sneeze brings on epistaxis; and extravasations are not unlikely to follow but slight causes within internal cavities. Thus constituting the hemorrhagic diathesis, we have, besides general irritability of the circulation, blood flowing through dilated and non-contractile tubes, sent thither in greater volume than in ordinary and healthy circumstances, thinner and more fluent than in health, and little if at all able to arrest its own course by assuming the solid form; further, the containing vessels are prone to give way, on application of the slightest violence. Not unfrequently, a febrile condition at the same time exists; and when it does exist, it increases the intensity of the diathesis.

Treatment.—The history and appearance of any patient having made us aware of the presence of this morbid state of the general and circulating systems, every precaution will be adopted to prevent solution of continuity in any way—by wound, tear, or ulcer; more especially during early years. And at the same time, treatment will be adopted to oppose the diathesis and accomplish its removal. It resembles scrofula; tonics, such as used in that disease, will be of service; patiently persevered with. It also resembles scurvy; citric acid is all-powerful in the one morbid state; it is likely not to be without its good effect in the other. Occasional smart purgative doses of sulphate of soda will prove beneficial in two ways; as a purgative and hydragogue, diminishing the amount of serum in the blood; as a chemical salt, seeming to have the effect of increasing the blood's power of firm coagulation.

In the crisis—wound and hemorrhage having occurred—our attention will be directed to the fulfilling of two indications; amendment of the state of the blood, and amendment of the state of the capillaries, with a view to a hæmostatic result. 1. We shall endeavour to increase the blood's power of coagulation, more especially its power of forming a dense coagulum. If possible, we would increase the proportion of fibrin. The induction of an inflammatory action might effect this; and the attempt may be made, at a distance from the bleeding part. The adventitious action might prove useful in two ways; first, by increasing the proportion of fibrin, as all true inflammations do; secondly, by having a derivative effect on the source of the hemorrhage. But again, the excitement of the general circulation, apt to follow, will prove disadvantageous; also, the propriety of wilfully inducing a true inflammation, in such a system, may be seriously questioned. On the whole, this is a matter which can only be determined by the results of actual experiment; in which particular we are still deficient. Simple irritants, and dry cupping, however, seem certain to afford the beneficial derivation, unalloyed with the chance of untoward casualty; and therefore may be unhesitatingly employed. There is no time by tonics and diet to administer to the want of fibrin; that is the province of prophylaxis; yet, in the lingering cases, this indication will characterize our system of regimen. At first, we would give nothing in the shape of food or drink, being wishful to promote the state of nausea and depression, as favourable to the desired hæmostatic result. But should our first effort fail, and the bleeding continue, as is not improbable, we would then administer nutritious yet non-stimulant food, in small quantities and frequently; as soup, animal jelly, &c. Avoiding aqueous fluids; plethora of thin blood being far from advantageous. Avoiding also wine, brandy, and all other stimuli, which would excite the circulation adversely to hæmostatics; unless when driven to their use, at the eleventh hour, and in despair.

But though possessed of little power of contributing an increase to the amount of fibrin, we may endeavour to turn that which is already in the system to good account. Acetate of lead and opium favour coagulation, and calm the circulation; they are to be administered in full and sustained doses. The opium, besides, is supposed to have a tonic and astringent effect on the capillaries. Should the acetate of lead and opium be

found to disagree, they may be superseded by the sulphate of alum and potass, in doses of fifteen or twenty grains. Hydragogues, by diminishing the amount of serum in the blood, may contribute to its coagulability. Sulphate of soda, in purgative doses, will not only act in this way; but besides, as already stated, as a chemical salt it seems to favour the formation of a dense and firm coagulum. Support, as already recommended, is at the same time essential, to counteract the debilitating effect of this and such like evacuating remedies. For chemical reasons, however, the sulphate of soda cannot be given in conjunction with the acetate of lead. Nauseant remedies not only moderate the heart's action, but plainly favour coagulation of the blood for hæmostatic ends. Cautious and small doses, of ipecacuanha or tartar emetic, so as not to produce actual emesis, are therefore expedient at the commencement of the case; artificially to induce the favourable state of depression, analogous to faintness from loss of blood, while as yet much waste of that important fluid has not occurred.

In conducting the treatment, one circumstance should never be forgotten; namely, that in this disease the chance of success diminishes with the duration of the bleeding; and that, therefore, the first few hours should be occupied by an especially zealous and sustained employment of the requisite means. After excessive loss of blood, the remainder of that fluid, originally poor in fibrin, becomes almost wholly defibrinized; and consequently but little hope of arrest by coagulation can be entertained.

The second indication is directed to the state of the vessels. Opium, we have already seen, is likely to exercise a beneficial influence in this respect. Topically, we have a large catalogue of styptics from which to make selection. In mucous surfaces, both turpentine, and the fluid nitrate of mercury, have often proved highly advantageous; and may be judiciously employed, as local adjuvants to the general means of arrest. But for general application, I am inclined to prefer the nitrate of silver; not as a mere styptic, and trusted to alone; but as preliminary and adjuvant to what is to be considered the principal local means of arrest—pressure. The nitrate is used so as for a time to restrain the flow, and permit the apex of a graduated compress to be laid in a dry bed, in the manner formerly detailed. And this compress is retained by bandaging, or otherwise, so as to exert a moderate and constant pressure on the source of the hemorrhage. A great amount of pressure must be carefully avoided; for both part and system are intolerant of this; ecchymosis, sloughing, and ulceration, with much constitutional disturbance of a low and irritable type, will certainly follow; and in a short time the blood will burst forth, from a wider surface, and with a more willing flow than before. Also, never let a soaked and oozing compress be trusted to; but let it be at once removed, and the dressing be more accurately re-adjusted.

The actual cautery, enjoying a general reputation of being at once the most severe and most powerful of local hæmostatics, has naturally been much employed in those desperate cases; but invariably with an evil issue; as can, indeed, be readily understood. The slough or eschar, which is formed, arrests the flow for a time, while it is yet

adherent; but the process of detachment is, in such cases, both an early and a rapid one; and the ulceration, opening up parts devoid of plastic exudation, certainly re-induces the hemorrhage—and that too in an aggravated form. In the hemorrhagic diathesis, the actual cautery should never be employed; there is an intolerance of the remedy itself; and besides, the parts are by its use rendered incapable of bearing the subsequent application of pressure.

Deligation of the principal arterial trunk, too, cannot but fail in such cases. The oozing is from the capillaries; and their circulation, it is well known, will not be sufficiently affected by any such procedure.

The treatment having failed to arrest, and the condition of the patient having become almost hopeless, one effort may still be made for his life; by transfusion. Not from a plethoric person; for it is not the red corpuscles we desire. But from a person in all respects healthy yet robust; the blood abounding in the desiderated fibrin. Nor should this operation be delayed until the patient is quite in extremis; let it be performed at a time sufficiently early to afford a reasonable prospect of success. One risk plainly attends its performance; namely, the making of an additional wound, which, in its turn, may assume the indomitable tendency to bleed; but experience has shown that such is not invariably the result.*

CHAPTER XIII.

PERVERTED VASCULAR ACTION IN THE LYMPHATICS, OR ANGIOLEUCITIS.

ANGIOLEUCITIS is of very frequent occurrence. It may appear without any appreciable cause; more commonly it is the result of external injury. The superficial lymphatics are most frequently involved. And the action seems to be connected, in the great majority of cases, with the absorption of deleterious matter; either from without, or generated in the part as a product of the inflammatory process.

If a wound exist, it becomes inflamed, and the action has a tendency to the erysipelatous character. Painful sensations shoot upwards from it; and streaks or bands, of a bright redness, appear on the previously sound skin; not continuous with the original inflammatory process, but usually at some distance from it; tortuous, irregular, and intersecting each other so as to form small islets of skin yet unaffected; following the course of the superficial lymphatics; and dependent on an erythematous condition of the skin above the inflaming vessels. Sometimes the limb presents an appearance as if attacked by slight erysipelas, at many unconnected points. The pain is hot and burning, and increased

* London and Edinburgh Monthly Journal, vol. ii. p. 567.

by pressure ; and the vessels feel hard and corded. Swelling is always considerable, often great, and affords a spongy sensation. The red streaks extend upwards, often with much rapidity ; sometimes continuous throughout ; but not unfrequently the skin shows intervals of apparent immunity. The ganglia, in their course, become involved ; and swell acutely and painfully. Very frequently erysipelas supervenes ; the distinct streaks of the angeioleucitis then becoming merged in the continuous redness of the new disease. The general symptoms are usually ushered in with rigors, and at first evince the true inflammatory type. Sometimes a simply febrile state, as in erysipelas, precedes the appearance of the local disorder. As the latter advances, the inflammatory type of the constitutional symptoms is more or less rapidly departed from ; and, in the great majority of cases, at all severe, the typhoid character, is ultimately developed. Sometimes this is the type of the general disorder from the beginning ; dependent partly on previous weakness of system ; partly, as in all cases of the disease when advanced, on the introduction of deleterious matter into the circulating system, the product of the advancing inflammatory process.

Resolution may occur ; the process stopping short of suppuration ; and the part gradually recovering from the acute infiltration. Or the action, either originally or secondarily of a chronic form, may cease ; and yet resolution may not ensue ; the part remaining indurated, and absorption of the fibrinous deposit taking place very tardily, if at all. Or the action, acute, proceeds to suppuration ; and this may occur within the vessels, or in the cellular tissue exterior ; usually in both. In the former situation, the existence of pus is not so readily detected as in phlebitis ; there is no fluctuating swelling ; but there is the accession of a similar train of alarming typhoid symptoms dependent doubtless on the same cause—the admixture of purulent or puriform secretion with the general circulation. The external suppuration is indicated by the ordinary signs ; sometimes assuming the character of abscess, or of a chain of abscesses ; more frequently, perhaps, the matter is diffusely infiltrated, the general symptoms becoming aggravated in consequence. In the unfortunate cases, the fatal issue is doubtless attributable to the suppuration ; more especially that from the vessels themselves.

The treatment is in the first instance actively antiphlogistic ; but under the same restrictions as inculcated in the case of phlebitis. In addition to the ordinary means of leeching, rest, regimen, purging, &c., much relief will be obtained from assiduous application of a hot and weak solution of acetate of lead and opium to the part affected. When external suppuration occurs, whether diffuse or limited, the matter should be evacuated by early and free incision. In the chronic form, threatening to leave induration, blistering is advisable. In the acute and aggravated forms, the same principles must guide as in the analogous cases of phlebitis ; support of the constitution, the mitigation of symptoms, and hope in the system's effort at revulsion and recovery. In those cases in which the constitutional disorder is from the first asthenic, active antiphlogistics are never expedient. Not unfrequently, erysipelas, phlebitis, or even both, co-exist ; such addition renders the

prognosis unfavourable, and demands modification of treatment to suit the circumstances of complication.

Inflammatory swelling of the lymphatic ganglia, as already stated, is one of the attendants on the spread of angeioleucitis. It often occurs independently of such preliminary disease; the result of excitement, either direct or conveyed from a distant part, and connected or not with absorption of deleterious matter. Simple strain, or ulcer, or wound of the foot, for example—as well as direct injury of the part itself—often induce acute inflammatory swelling of the inguinal glands; and the same parts are just as frequently affected, in an action more intense, by ulceration of the penis of a specific kind, accompanied by absorption of the venereal virus.

The swelling is rapid, prominent, and very painful; attended with more or less constitutional disturbance of the inflammatory type. It mainly depends on infiltration of the parenchyma, or ordinary cellular tissue of the gland, in which the inflammatory process would seem chiefly to reside. The conglomerated tubes themselves undergo change, such as usually results from the acute inflammatory process in that tissue; alteration of the coats, and of the secretion; it may be suppuration; seldom if ever obstruction—a circumstance very fortunate for continuance of the important function of absorption. The infiltration of the parenchyma may be simple and plastic; soon disappearing, by absorption, on subsidence of the action. Or, suppuration takes place; and abscess forms, either in the substance of the gland, or in the cellular tissue on its exterior. Or, the deposit, continuing plastic, does not resolve on subsidence of the action; but continues, forming an indolent and firm enlargement.

In most cases, more especially those of simple excitement, unconnected with absorption of deleterious virus, it is our object to arrest action and obtain resolution. Local depletion, by leeching, is naturally had recourse to; but experience says little in its favour; there are comparatively few examples of its apparent success; on the contrary, the irritant effect of the application seems rather to hasten the action onward. If leeching is employed, let it be at a little distance from the part affected. Usually, however, more trust may be reposed in the other antiphlogistics; rest, fomentation, relaxing position, antimony, and low regimen. If the crescent action be of the sub-acute form, benefit may often be obtained from the endermoid application of iodine, in solution, so as to desiccate and decolourize the integument. Many a simple and sub-acute bubo may be arrested by painting on the solution of iodine, at the same time maintaining rest and antiphlogistic regimen. When matter has formed, incision is to be made as under ordinary circumstances; suppuration is usually both profuse and long-continued afterwards. Poulticing and fomentation are continued for a few days; then water-dressing, medicated or not, as circumstances may require; and ultimately pressure is advisable, to hasten absorption of the fibrous infiltration in the glands' parenchyma, and at the same time to favour closure of the suppurating track and cavity. If the suppuration have taken place only in the subcutaneous cellular tissue, the skin is usually considerably undermined. The opening is large, and closure

is delayed by projection and interposition of the yet entire glandular tumour. In such circumstances, pressure is to be tried; directed with some energy on the offending part. And if this fail, the potassa fusa should be freely applied to the interior of the enlargement, as if by transfixion, so as to ensure its entire suppuration and consequent disintegration. Thereafter, the sore is to be treated in the ordinary way. Sometimes a glandular enlargement, originally acute, ceases to be so, and hangs undecided between progression and recedence. For this state nothing is so suitable as an active blister. It decides the question in one way or other; either absorption or suppuration follow. In the truly indolent swellings, pressure is to be employed, with occasional counter-irritation; and the iodide of potassium is to be given internally. Should the method by discussion fail, both part and system may be continuously stimulated, so as to induce suppuration in the changed part. Buboës, of venereal origin, are amenable to certain peculiarities of treatment, as will afterwards be noticed.

Glandular Tumours.—Nothing is more common than enlargement of the lymphatic ganglia; but the great majority of such swellings have their origin in the simple inflammatory process; never demanding the extirpating knife; always amenable either to discussion or to suppurative disintegration. Occasionally, however, the glandular parenchyma is the seat of genuine tumour; perhaps supervening on the simple inflammatory enlargement; more frequently wholly independent of this. Then, one or two glands only are affected; not a whole cluster or chain, as in the other case; the growth is more steady, the swelling more distinct; and in other respects the characters of the enlargement are such as belong to tumours generally—to be afterwards described.

CHAPTER XIV.

PERVERTED VASCULAR ACTION IN THE NERVOUS TISSUE.

THE effects of perverted vascular action on this tissue are of course most apparent in the nervous centres; but there seems no reason to doubt, that similar effects follow similar causes in the nervous ramifications also. The first change is a tumescence, with increase of the supply of blood. On making a section of the affected part, numerous red spots are seen, marking the blood-vessels; and in some places there may be a red striated appearance; in consequence of extravasation; sometimes small coagula are found. The increased amount of blood may heighten the general colour of the affected part; the cortical substance assuming a dark red or brownish colour, while the medullary is of a lighter tint. Action continuing, the ordinary exudations result; the tissue softens, and may become of almost semi-fluid consistence. According to the nature and extent of the effusion, the colour, density, and general character vary; if blood be extravasated, the softening is red; yellow, when pus has been formed; gray, when blood and pus are co-mingled; whitish, when serum alone has been effused. The latter condition, as can readily be understood, can only be the result of a chronic and minor action. The cineritious matter is more prone to undergo such changes, than the medullary; probably on account of superior vascularization.

Softening of nervous substance, found after death, may be unconnected with vascular action. The distinguishing of such post-mortem disorganization from that which is truly inflammatory, is not easy to the naked eye; but is said to be simple, by the aid of the microscope. "The inflammatory softening is characterized by the presence of exudation corpuscles and granules, whilst, in non-inflammatory softenings, these bodies are never found."

The nervous is just as liable to suppuration as any other texture. The matter may be limited, as in ordinary abscess, by its cyst, and by condensed tissue around; or it may be diffusely infiltrated, producing the yellow softening and disorganization. The abscess, also, may be acute, following the ordinary course, and marked by symptoms of great intensity; or chronic, most insidious in its progress, and consequently of a highly dangerous character.

Induration and enlargement of structure follow chronic action; and are usually the remote result of some injury done to the part.

Ulceration is doubtless concerned in the process of softening; peculiar to acute action. And in progressive ulcer, wherever situated, nerves, though for a time resistful of the destructive process, ultimately

give way before it. Sometimes ulcer seems to originate in the nerve, giving rise to most untoward symptoms, when that tissue has become the seat of inflammatory action subsequently to laceration, bruise, or other similar injury.

Gangrene is comparatively rare; yet occurs as in other parts. The nerves of a limb slough and separate, as do the other component textures; and sloughing of the protruded cerebral mass, is far from uncommon in hernia cerebri.

The causes of perverted vascular action in nerves, are usually traumatic; puncture, section, laceration, bruise, inclusion by ligature. The idiopathic form is rare. From simple wound, a minor and somewhat chronic grade of action usually results; producing a bulbous expansion of the cut end of the nerve, by deposit of plastic fibrin between the fibrillæ, and corresponding hypertrophy of the investing neurilema; a condition termed *Neuroma*, when the swelling is of considerable size, and the seat of anormal sensations. A similar result usually follows injury by deligation. Puncture, laceration, and bruise, are more likely to be followed by a true inflammation, producing softening and suppuration, ulceration, or even death of the part.

The symptoms which attend on the inflammatory changes in nerves, are, in the acute form, great pain, rendered excruciating by pressure, and shooting in the direction of the nerve, or nerves, affected; heat, and throbbing; not unfrequently a tendency to jerking of the muscles implicated; inflammatory fever of a marked and intense character; and, in the more urgent cases, the nervous centres are apt to be involved in obvious derangement of function. In the chronic examples, such as result in the formation of *neuroma*, the pain may be equally severe, but is not so much aggravated by pressure; heat and the ordinary signs of acute inflammation are absent; and the system is not involved in inflammatory fever, but rather wasted by disorder of an adynamic type, resembling an ordinary hectic. If a *neuroma* form, and be superficial, the painful, hard swelling can be distinctly felt.

Treatment is conducted according to the ordinary antiphlogistic principles; activity being proportioned to the nature and urgency of the case. *Cæteris paribus*, the nearer the part affected is to the nervous centres, the more important is the case, and the greater the expediency of active measures for relief.

Neuralgia.

This denotes increased and perverted sensation in a nerve, unconnected with the inflammatory process, or with change of structure, at the part where the pain is felt. The affection is of two kinds, as formerly stated; unconnected with organic lesion, at any part of the nerve's course, or at the nervous centres, and entirely functional; or, as more frequently happens, connected with organic change, acute or chronic—more frequently the latter—at some part of the nerve's course, or at the nervous centres. The one is an example of pure irritation, or functional nervous derangement; the other may be termed—irritation, dependent on organic lesion at a distant part of the nervous tissue.

The nerves most liable to Neuralgia are the fifth pair, and the sciatic ; the former more especially.

The pain is intense, but intermittent ; sudden in its onset, also abrupt in its decadence ; shooting or plunging in its character, and often quite excruciating ; readily induced by the slightest external impression affecting the mere surface ; but not aggravated by firm pressure on the part ; on the contrary often relieved thereby. Occasionally, delirium seems to ensue from the mere severity of the suffering. Tic-douloureux, affection of the fifth nerve, in the face, is a familiar example of the gravest form. Not unfrequently, the paroxysms are periodical and regular in their accession ; and muscular spasm is a common attendant on the paroxysm. Some neuralgic patients suffer especially in certain months of the year.

Rheumatic pains not unfrequently follow the course of the nerves ; dependent on affection of the fibrous neurilema. But such pains are not truly neuralgic. They are less intense, less intermittent, less paroxysmal, and associated with the ordinary rheumatic accompaniments.

The *cause* of Neuralgia is usually obscure. There may be no organic change in any part of the nervous tissue, as already stated ; and the cause of the purely functional derangement may prove quite inscrutable. Or there may be disorder of some internal organ ; apparently connected with the neuralgy, in the relation of cause and effect ; the latter disappearing, when the former has been removed. A neuralgic pain of the leg or foot, for example, has often yielded to treatment directed to removal of noxious matter from the intestinal canal, with restoration of the normal secretions.

Sometimes the neuralgy seems dependent on an irritation, less formidable than itself, in a different part of the same nervous expansion. Violent neuralgia of the infra-orbital nerve, for instance, is often assuaged, or perhaps cured, by removal of a decayed or otherwise altered tooth, which may have been occasioning but little apparent disturbance in its own immediate vicinity.

A spiculum of bone, or mere enlargement of an osseous canal, may so compress and irritate a passing nerve, as to induce neuralgia in its extreme expansions. And it is supposed, with probability, that a similar result may follow compression of a nerve in an osseous canal, by change in the accompanying blood-vessels—expansion, by local determination—independently of any alteration in the osseous texture.

Very frequently, organic change, existing at some part of the nervous tissue, may reasonably be judged the cause of the neuralgy. A thickening or enlargement of the nerve, at some part ; or a disorganization, or congestion, or effusion, at some part of the nervous centre, near the origin of the nerve or nerves affected. In chronic disease of the upper part of the spinal cord, and lower and posterior part of the brain, there is no more frequent or distressing class of symptoms than plunging neuralgic pains, with muscular spasms, in the lower limbs.

But, whatever the exciting cause, there seems to exist some predisposing origin of neuralgia, which we cannot define ; a constitutional tendency to the disorder, which may, and does, of itself maintain the

malady, after every appreciable cause has been sought for and removed; and which doubtless is the sole origin, in those cases in which no exciting cause can be detected, even after death. In the case of neuralgia, apparently dependent on neuromata, for instance, these may be taken away by incision, and the wound treated most carefully; yet the same painful feelings are very prone to return, before fresh neuromata have had time to form; and may continue, even when careful manipulation satisfies the surgeon that additional neuromata have actually not been produced.

Hysteria obviously predisposes to the disease, and may sometimes also prove the exciting cause. But in these cases, the pain is not so apt to follow the course of nerves, but rather to settle on the surface of a part, or even on an internal organ.

The termination of the disease is not uniform. It may yield to treatment. Frequently it defies all remedies, and suddenly disappears spontaneously; the cause of decadence proving still more mysterious than that of accession. The continued irritation may induce serious change in the nervous centres; and the result may be apoplexy, or insanity. Or the irritation may simply exhaust the patient, by emaciation and hectic.

Treatment.—Our first and most obvious duty is, to anxiously seek for, and detect a cause, if possible; and, having found it, to effect its removal, if this be in our power. Disorders of the uterus are to be remedied; intestinal irritation, by lodgement of noxious matter, or otherwise, is to be subdued; dyspepsia to be remedied, if possible; offending teeth or stumps to be extracted; neuromata, or painful subcutaneous tubercles, to be excised; foreign matter, lodging in the neighbourhood of the nerve, to be carefully taken away. If chronic change of structure be suspected in the substance of the nerve, at some distant point, let moderate leeching, followed by patient counter-irritation be employed at that part, with the view of remedying such change; assisted, if need be, by the internal use of the iodide of potassium, or other auxiliaries to discussion. If the brain or spinal cord be suspected, treatment must be mainly directed to these important parts. It is not uncommon to find neuralgia connected with great tenderness of certain vertebræ; and such cases often yield readily to leeching there, followed by counter-irritation, and rest.

To the seat of pain various applications may be made. In some cases, it has been thought that good has resulted from the use of the moxa or actual cautery; but such remedies are more suitable to those parts where actual change of structure is either known or suspected. Soothing applications are more appropriate to the seat of pain. Opium, belladonna, aconite may be used in the form either of epithem or of liniment; or their salts may be exhibited by the skin—either by inoculation, or after abrasion of the cuticle by vesication. Veratria and hydrocyanic acid are also not without their effect as local anodynes. Simple blistering and rubefacients sometimes afford relief.

Internally, anodynes may be given. In some cases, it is of the utmost importance to palliate in this manner, without any expectation of cure; preventing exhaustion of the frame from continuance of intensity of

pain. Opium may thus be found expedient in large doses ; and yet it should always be used warily, lest it accelerate and aggravate the cerebral disorder which the disease itself tends to induce.

Not a few remedies are exhibited internally, almost with empiricism ; considered available to counteract that hidden perversion of system, on which neuralgia seems much to depend. Subcarbonate of iron is given in large doses ; along with occasional laxatives, to prevent the bulky medicine from accumulating in the interior. It is especially useful in those cases, in which the disease is obviously connected with an anæmic condition. Quinine and arsenic are both of much repute, especially in those cases in which the periodical accessions are most marked. Colchicum is likely to prove serviceable, when a suspicion exists of rheumatic origin or complication. Turpentine, too, has sometimes proved of use ; especially in affections of the sciatic nerve. Croton oil, used as a smart purgative, has often afforded relief ; perhaps on the principle of counter-irritation.

Stimulants of the nervous system have been tried, and with some success. Relief has followed the application of electricity and galvanism directly to the nerves, by means of acupuncture ; and the internal use of strychnia, in doses of a twelfth of a grain, has also effected alleviation.

In all cases, it is most important to commence the internal treatment by evacuants, followed by alteratives ; and to persevere in the simple use of these, until the primæ viæ exhibit satisfactory evidence of a normal state, as to contents and secretion. There are but few cases, also, which will not receive benefit from change of air ; more especially if the change be from a humid, relaxing climate, to one which is dry and bracing.

Interruption of continuity in the affected nerve, by excision of a portion, has been tried extensively, but with so little success as scarcely to warrant repetition of the experiment. In many cases relief is obtained for a time ; but soon there is restoration of the nerve's function, if not of its absolute continuity of structure ; and the pain returns, perhaps in an aggravated form. Excision, therefore, is now prudently limited to those cases, in which an obviously altered portion of the nerve affected can be safely and completely taken away.

SECTION III.

PERVERTED NUTRITION.

CHAPTER XV.

OF TUMOURS.

PERVERTED nutrition has already occupied our attention, as a result of the inflammatory process; inducing hypertrophy, induration, and other change of original structure. Under the present section, we have an example of perverted nutrition of a different kind, constituting Tumour; which may be defined:—A morbid growth, or new structure; the result of perverted nutrition in a part; independent of the inflammatory process, otherwise than as an exciting cause; possessed of a formation and increase distinct from those of the original tissues.

The *origin* of tumour is yet a question unsettled. Some still assert that extravasation is the first step; and that the extravasated blood, becoming organized, forms the nucleus and origin of the morbid growth. But there is much doubt as to the fact of an extravasated coagulum ever becoming fully organized; it may seem to be partially injected from the surrounding living parts; but such injection may be, and probably is, itself little else than an extravasation. The preponderance of opinion leans much to the side of non-organizability of the coagulum—as such; and by all who entertain such an opinion—among whom I would beg to be enrolled—it is consequently held that in this manner tumour does not originate. What led to the supposition was, no doubt, observation of the fact, that the morbid formation was in very many cases attributable to the receipt of external injury. A part was struck, extravasation followed, the extravascular blood was felt hard and clotted, the hardness became less but did not altogether disappear, a firm knot remained; this, after a time, began to enlarge; increase continued, and an avowed tumour became developed. But this chain of events—of very frequent occurrence in connexion with tumour—can be explained otherwise than by supposing organization, with subsequent growth, to take place in an imperfectly absorbed coagulum. The coagulum is removed, and fibrinous exudation occupies its place; effused by the inflammatory process which the stimulus of the injury has excited. Under ordinary circumstances, this exudation merely

accomplishes the ordinary salutary end in view ; namely, restoration of the continuity of texture, which the extravasation had broken up ; and, on this end having been attained, redundancy of exudation disappears by absorption, and the normal condition of texture is more or less completely restored. But not unfrequently, the absorption is incomplete ; a redundancy of fibrinous plasma, in process of organization, remains ; formative action of the blood-vessels continues in an exaggerated though simple form, in the seat of exudation ; the plasma is added to, while the surrounding textures are undergoing merely the quiet and healthful changes of ordinary nutrition ; the swelling increases ; and its growth is now distinct, and independent of the surrounding parts. This we believe to be the most frequent mode in which the simple tumour originates ; not from the organization of extravasated blood ; and not as a direct result of, or attendant on, the ordinary inflammatory process ; but this and the extravasation being rather related to it, as the exciting cause. The blow and extravasation are followed by fibrinous exudation, the result of an exaggerated nutrition, effected by the inflammatory process, with a restorative and salutary object in view ; the exudation is redundant, and the excess is not wholly absorbed ; continuance of the deviation from the normal structure, induces a continuance of exaggerated nutrition at that part ; accumulation of organizable plasma results ; and commencement of a new growth is established ; its origin, the result of nutrition simply exaggerated ; its subsequent growth, the result of nutrition decidedly perverted. If this morbid local increase of deposit be of a simple, fibrinous, and plastic character, a simple tumour results ; but if, from constitutional vice, or other causes, it have departed from the ordinary fibrinous character, then the resulting tumour equally deviates from similarity to the original texture.

Tumours, accordingly, are said to be *Analogous*, when their structure is of a simple kind, and resembles some normal texture ; as fat, fibrous tissue, parenchyma, bone—*Heterologous*, when they bear no similitude to the normal tissues ; as do carcinoma and melanosis. This division, however, is to be considered as holding good only so far as the naked eye is concerned ; for, microscopically observed, the carcinoma in its intimate structure differs nothing from the simplest normal formation.

A more useful division of tumours, is into the *malignant* and *non-malignant*. The latter term being applied to those which do not consume the surrounding textures, by involving them in the same degenerated structure with themselves, but simply push them aside, condensing them into the form of an enveloping and limiting cyst ; which prove injurious chiefly by bulk and position ; which, when thoroughly removed, have no tendency to reproduction ; which, in short, are mere local changes, unconnected with constitutional cachexy. On the other hand, the malignant tumours—to the naked eye heterologous—efface the normal texture of the part in which they form, and ever seek their own extension by further change of surrounding textures into resemblance of themselves ; they are connected with constitutional disorder ; their

bulk is not so injurious, as the pain, hectic, and exhaustion which attend on their advancement; when removed, there is no guarantee that they shall not be reproduced, in the same or another site; in one sense they are not themselves a local disease, but rather the local indications of a disease which has a constitutional seat and origin. Of the simple or non-malignant tumours, take the adipose, or the fibrous, as examples; of the malignant, the carcinomatous or the medullary. Others, again, may be considered as holding a middle place between the two great classes; having some of the characters peculiar to each. The tubercular or scrofulous tumour, for instance, is heterologous and dependent on a constitutional vice; yet it does not invade contiguous parts, and does not tend to the foul ulcers and fungous growths of the truly malignant formations.

The *chemical constitution* of tumours varies; but not so definitely as the systematic writer could wish. The proximate animal principles which are chiefly found in them are—fat, gelatine, and albumen; and according as any of these predominates in the structure, the nature of the tumour is found to vary. Those which consist chiefly or wholly of fat, contained in a cellular parenchyma, are analogous, simple, and non-malignant. Those which, by long boiling, are reduced almost entirely to gelatine, are also analogous and non-malignant. Those which consist mainly of albumen, include both analogous and heterologous formations; some are malignant, others simple; in the most malignant, as the carcinoma, there is little or no trace of gelatine, and the composition seems almost wholly albuminous.

The microscope has as yet made no great addition to this department of practical surgery. The elements of structure, in tumours, are found to be:—a filamentous substance, often distinctly fibrous; granular matter, small, but tending to form masses by aggregation; minute spherical particles resembling fat globules, and also much disposed to aggregation; cells, with or without nuclei, often of globular form, not unfrequently extended and of spindle shape; crystals, usually rhomboidal, supposed to be derived from oil or fat globules; a transparent fluid, supposed to resemble the liquor sanguinis;—not differing from the elements of the most simple and normal tissues. “Microscopical and chemical analysis can never become a means of surgical diagnosis; it were ridiculous to desire it, or to suppose it practicable.”* If after removal, however, either shall assist in arriving at a certainty of conclusion as to the malignancy or non-malignancy of a growth, prognosis will be usefully facilitated. And it is in that direction, after operation, that these collateral sciences promise to aid the surgeon.

The great majority of tumours are enveloped by a *cyst*. In some—those specially termed Encysted—it is the original and chief part of the structure; by secretion from which, the interior and bulk of the tumour is produced. In operation, the whole of this cyst must be either removed or destroyed, otherwise reproduction is certain. In others, as the adipose, the cyst is constituted secondarily, and consists merely of

* Müller.

the ordinary cellular tissue condensed into a membranous appearance by the pressure of the enlarging tumour; it adheres loosely to the growth, and is to be regarded as no part of its structure; when the tumour is removed, the cyst may remain, without any chance of reproduction therefrom. Certain tumours of a suspicious character, and yet not of avowed malignancy—as many examples of the cystic sarcoma—are enveloped in a stout cyst which is truly part of their structure, having become secondarily, if not originally, intimately incorporated therewith. This cyst must be taken wholly away, if we wish the operation to be satisfactory and complete. The malignant tumours usually are limited by no cyst; it is their nature to invade and involve neighbouring texture, not to condense and push it aside. Sometimes, however, a fibrous expansion for a time resists the invasion, and, while so successful, assumes the place and character of an ordinary cyst. That, too, in extirpation, must be taken away, even though as yet not fully incorporated with the diseased structure.

The tumour's *growth* may be, 1. By apposition; as in the tubercular. 2. By intus-susceptive cellular development, as in ordinary nutrition; the mode followed in the simplest form of tumour. 3. By both; as there is good reason to believe occurs in the carcinoma. Also, some tumours are produced by infiltration into the surrounding textures, and are incorporated with them; the simple sarcoma, for example, at its first formation. While others, as the fibrous, are from the very first distinct, and push aside the original texture.

That tumours are liable to *degenerate*, there seems no reason to doubt. And the possession of this belief ought to have a most important bearing on their practical treatment. The degeneration may proceed from one of two causes; general or local. While a tumour is yet simple, the constitution may undergo an untoward change, and cachexy be established; the tumour will then gradually sustain a corresponding alteration. In this manner a tumour of the breast, originally of a non-malignant nature, often insensibly passes from the simple to the carcinomatous structure and tendency; the signs of the degeneracy in the system preceding those of the evil change in the part. Or, on the other hand, the system yet remaining apparently unchanged, the tumour itself degenerates, in consequence of repeated local excitement; as by blow, puncture, or stimulant malapraxis. The tumour's ordinary growth, as has already been stated, is unconnected with the inflammatory process; but the tumour's structure, like other organized textures, whether original or secondary, is liable to assume that action. When assumed, it may advance to the ordinary results. A recent simple sarcoma, or a tubercular tumour of any standing, may suppurate, and disappear by disintegration. A circumscribed tumour of any kind, sometimes, though rarely, is reduced to the condition of a slough, and may so be extruded, as it were by Nature's own operation. Ulceration is an extremely frequent result, in any excited tumour, and more especially in those of malignancy. These are the open and avowed results of the inflammatory process, of a high grade, in tumours; the more chronic and minor action is less marked in its operation, but equally decided and often more untoward in its effect. At first, it may cause mere acceleration

of the growth, by increase of the same deposit as before; the tumour enlarges, but is yet of its original simplicity of structure. But after a time, the deposit changes into the kakoplastic; the action is altered; the nutrition is not merely exalted, but perverted. The tumour then increases, perhaps more rapidly than before; but there is more than mere increase, there is degeneracy to boot; the simple passes rapidly, and with marked indications, into the malignant form. All tumours are liable so to change; but some more than others. Of the simple tumours, the cystic may truly be considered the most disposed to evil; while the fibrous evinces the least tendency to depart from its original nature. The exciting cause of change, when of the local kind, may be accidental injury; but much more frequently it is the repeated and ill-advised application of stimulus, wilfully, in the vain hope of discussing, by absorption, what is not amenable to such mode of removal.

Certain tumours may be made to disappear by *absorption*; and to these the cautious application of stimulus, with that end in view, is a commendable and safe procedure; but, unfortunately, these constitute but a small minority of true tumours. The simple sarcoma, a mere organized accumulation of fibrinous matter, may be discussed, and so may the scrofulous tumours. But all others resist discussion, and can be removed only by the knife. If the attempt to discuss be persevered in, nothing but evil results. 1. Their growth is accelerated. That is of itself an evil. The simple tumour, as such, proves injurious chiefly by its bulk and position; by accelerated growth that injury is obviously enhanced. At first, the tumour, when small, could be removed by operation, with ease and safety to surgeon and patient; but, in consequence of the increased bulk, deeper and wider incisions become necessary, important parts are encroached on, and the operative procedure becomes one of difficulty and danger. 2. Adhesions are rendered both more numerous and firm. A fatty tumour, for example, uninterfered with, long remains very loosely connected with its delicate investing cyst, even when of large size; but after repeated stimulation, the adhesions become so dense and numerous, as almost to incorporate the cyst with the tumour. At first, little more than a mere incision might have sufficed for removal; afterwards a painful, tedious, and careful dissection is required. Many a tumour has thus been brought not only into contact with important parts, but also rendered firmly adherent to them. 3. Degeneration is favoured, by causing an exaggeration in the perverted nutrition, as has been already explained; nay, such degeneration may be not merely favoured, but directly produced by the malapraxis, while both tumour and system had previously no disposition towards any such untoward change.

The tumours capable of being dispersed by absorption are the simple sarcoma, and the tubercular or scrofulous. All others resist discussion; and perseverance in the attempt can only induce more or less of the evils above enumerated.

Not unfrequently, however, discussive treatment may be applied with the best success, not as itself a means of cure, but as an adjuvant and preliminary to operation. Thus, a carcinomatous tumour may be of such enormous apparent dimensions as to render extirpation a pro-

ceeding of much danger, if not impossible; and had we no means of diminishing the bulk, and consequently limiting incision, we might be compelled to leave the patient an unaided victim of the disease. But we know that, in most cases, much of the bulk is not really due to the tumour itself, but consists of the common products of the inflammatory process in the cellular and other tissues exterior to it. By discussives, judiciously employed, that outer swelling may be absorbed; and the mass, then reduced to almost half its former size, may be dealt with by operation fearlessly. Let not the discussives, however, be persevered with or pushed so far as to attack the tumour itself; otherwise its morbid nutrition is excited, and the result is the opposite of that which we desire.

All tumours sympathize with excitement of the general system; and have their nutritive action proportionally augmented; as during febrile accessions, by sustained violent exercise, by mental emotion, and by the occurrence of the menstrual period. At such times, too, as can be readily understood, degeneration is most liable to occur.

From what has been said, it follows that long delay of active treatment of a true tumour—that is, by extirpation—is seldom if ever expedient. Unless it be of the simple or scrofulous kinds, it cannot be removed by absorption; meanwhile it is, though perhaps slowly, steadily enlarging, acquiring deeper and more important relations, and forming new and more intimate connexions; besides, it is every day liable to commence the process of transition into a structure and tendency of a more sinister kind. If the system be in evident disorder, if the part be in a state of temporary and accidental excitement, or if the bulk be great and not wholly dependent on the tumour—delay is advisable, until correction have been made so far as circumstances will permit. But, this having been achieved, means suitable for efficient removal cannot be too soon adopted.

Spontaneous cure sometimes occurs. 1. By absorption. We have already seen in what cases this mode of disappearance may be effected by art; it sometimes, but rarely, occurs spontaneously. 2. By suppuration. A simple tumour, as a scrofulous may inflame; and, suppurating to the core, may crumble down by disintegration. 3. By ulceration. A simple tumour may thus slowly disappear; ulceration commencing on the surface, and gradually extending to the interior; and the parts subsequently healing by a depressed and tight cicatrix. By the same action, we have already seen, an erectile tumour may disappear, partly by loss of substance, partly by condensation of what remains. 4. By sloughing. Any circumscribed tumour may be so extruded. Not by the action having, within the tumour itself, proceeded to its ulterior result; but in consequence of diffuse purulent infiltration having taken place in the surrounding cellular tissue, whereby that tissue sloughs. The tumour, deprived on all sides of its vital supply, rolls out, an inanimate mass. The three first modes of cure may be, and occasionally are, successfully imitated. The last is a rare occurrence in nature, and, like all diffuse infiltrations, is attended with no inconsiderable danger to both part and system; it cannot be imitated, with safety.

Tumours, also, are found to vary as to the power and probability of *reproduction*. Some have no such tendency. The simple tumours, taken wholly away by operation, are seldom, if ever, reproduced in the same site. Some may have even a part left behind, and yet fail to grow again; a simple sarcoma, or an adipose tumour, has sometimes been but partially removed—yet the cicatrix has become firm and permanent, and no subsequent increase has supervened. As a general rule, however, it is well to hold, that, in even the simplest formations, the whole of the morbid structure must be removed; so as to render it certain that reproduction shall not ensue. In all malignant growths, that rule is most imperative; the slightest fragment of the morbid structure, remaining, is sure to become the root from which a fresh formation will speedily arise.

Tumours are very various in their nature; and occasionally examples present themselves, differing from any of the classes usually described. It is impossible to construct a *classification* which shall embrace every tumour. We attempt only that which may include the majority; arranging them, also, in a form at once convenient for description, and suitable for enforcement of the practical details of treatment.

There are *Tumours of the soft parts*, and *Tumours of Bones*. We shall consider the former in the first place.

They are *Solid*; consisting of a more or less compact fleshy growth, whose enveloping cyst is entirely of secondary formation. Or they are *Encysted*; the cyst, the original structure, and by its secretive power maintaining the bulk and increase of the morbid growth.

The solid tumours, again, are *Simple* and *Malignant*. I. In the former class are the *Simple Sarcoma*, the *Adipose*, the *Fibrous*, the *Cartilaginous* the *Calcareous*, the *Osseous*, the *Cysto-sarcoma*. II. There is a tumour locally simple, but accompanied with and dependent on a constitutional vice; the *Tubercular*. III. The *Malignant* are, the *Medullary*, *Carcinoma*, *Melanosis*, and *Fungus Hæmatodes*. These solid tumours of the soft parts we shall consider in detail.

The Sarcomata—Non-malignant.

I. THE SIMPLE TUMOUR, OR SIMPLE SARCOMA. The “common vascular sarcoma” of Abernethy. This consists of an accumulation and organization of plastic fibrin; which, subsequently to organization, comes to assume the characters of an hypertrophied and condensed portion of ordinary fibro-cellular tissue. Very frequently, it occurs in a glandular secreting structure; but it may form in any soft texture, and in any region of the body. At first, it may be termed a mere hypertrophy, the result of exalted nutrition. That constitutes the first stage of its formation; when it may be regarded rather as the nucleus of the real tumour, than the tumour itself; differing from the ordinary fibrinous result of a chronic inflammatory process of a low grade, in being limited and circumscribed, in one spot; steadily advancing without either marked exacerbation or remission; and unaccompanied, as well as not imme-

diately preceded, by the usual characters of the inflammatory process. During this stage, too, the deposit is interstitial. In the second, nutrition is more decidedly perverted; inasmuch as the normal characters of the original texture are plainly departed from; the cells become occupied by a dense fibrinous deposit; and this is continued, not interstitially, as to the normal texture, but within the structure of the morbidly changed part; the surrounding textures being simply condensed, and pushed aside, to form an enveloping cyst, to which the tumour more or less intimately adheres by cellular and vascular connexions. On a section being made of the mass, the original texture is seen forming as it were the skeleton of structure, which mainly consists of recent fibrinous deposit, more or less fully organized. The growth, as already stated, is at first by interstitial deposit in the original texture, and subsequently by intus-susceptive cellular development within the morbid structure. To the second condition—that of distinct nutritive growth, with displacement, not involvement, of the surrounding original textures—the term tumour is with propriety limited.

The *external characters* are, a smooth surface—except when one or more such tumours are in connexion, as sometimes happens in regard to lymphatic glands—although these, as already stated, are infinitely more liable to mere inflammatory enlargement than to the formation of a real tumour; a tolerably firm yet doughy feel; no fluctuation; no elasticity simulating fluctuation; little or no pain, on even free manipulation; looseness of connexion, and no implication of adjoining parts; a steady, painless increase of bulk, more tardy than the growth of abscess, of inflammatory enlargement, and of malignant formations; no indication of a higher amount of vascularity than a similar bulk of the normal texture would naturally be expected to possess. The size may vary from the smallest to an indefinite extent; such formations have been found, after many years' growth, seeming as if a second body, and weighing many tens of pounds.

Treatment.—This is the tumour most capable of being removed by absorption; more especially, when it is yet recent, and scarcely removed from its first or nascent stage. The part is to be placed and kept in a state of comparative, if not of absolute repose. By moderate but repeated leeching, from the vicinity of the part, the morbid nutritive effort is diminished or wholly arrested; and then, by counter-irritation, and stimulation of the absorbents, gradual retrocession is patiently expected. Gentle blistering may be employed; or iodine, in the form of ointment or solution; or mercury, in ointment; or pressure; or plasters of galbanum, ammoniac, mercury, or other discutients. At the same time, the state of the general health should be seen to; and iodine may be administered internally. The local stimulation is proceeded with warily, lest vascular excitement ensue, and the tumour grow more rapidly than before; if so, rest and depletion must be again employed.

By carrying the vascular excitement to a higher grade, however, removal may be obtained; by suppuration of the interior; by ulceration extending from the surface; or by sloughing of the whole, in consequence of diffuse cellular infiltration around, as was formerly shown. These, however, are circumstances to be watched and taken advantage

of, when they occur spontaneously; not to be artificially induced; unless at the express and urgent desire of the patient, when the tumour is of small size, and when it is not situated in the neighbourhood of important parts.

Attempted discussion having failed, extirpation by the knife is to be had recourse to, at a yet early period; before any great size has been attained; when the morbid structure is yet loosely connected with the surrounding parts; when no deep-seated and important vessels, nerves, cavities, or canals, are yet in close contact; and ere any opportunity has been afforded for degeneration.

II. THE ADIPOSE TUMOUR.—This is a truly simple formation; and of very frequent occurrence, more especially in those parts where the adipose tissue naturally abounds. Two distinct forms occur. 1. *Lipoma*.—This is an exaggeration of the ordinary adipose tissue; the fatty matter being separated into innumerable isolated compartments, by the walls of the contiguous cells; invested by a fine cellular expansion; and this again enveloped in a more membranous cyst, to which the tumour slightly adheres. Sometimes, the growth is of a diffused character, without any marked distinction between the surrounding parts. Not unfrequently, the integument has undergone hypertrophy, as well as the subjacent tissue. 2. *Cholesteatoma*, or Laminated Adipose Tumour.—This is composed of concentric layers of adipose cells, whose contents have a lustre like mother of pearl; the adipose substance is of the consistence of tallow, not found exclusively within the cells, but likewise deposited in their interstices. The investing membrane and cyst are still more delicate than those of the lipoma. On a section being made, the laminated structure is usually very apparent; and the different layers can be readily separated by the point of the knife. A certain amount of cholesterine is found to enter into its chemical constitution. 3. A third variety, less frequently encountered, is the *adipose cyst*; which, indeed, may with more propriety be ranged among the encysted tumours. Fat, partly in a solid state, partly in the form of globules, and free from adipose cellular tissue, is contained in a large cyst, with dense parietes. The ovaries are the most frequent seat of this disease. All the varieties are but very sparingly supplied with blood-vessels.

The lipoma and cholesteatoma are the most frequent forms of this tumour. The former is always lobulated, usually in all its aspects, and irregular in form; flat, globular, cylindrical, according to circumstances. The latter is non-lobulated; generally round or oval in form, and not unfrequently studded on the surface by small elevations or nodules of a peculiarly lustrous appearance; which, however, are not appreciable till after removal. Of the two, the lipoma is much the more common. The sensation imparted to touch is one of elasticity, closely simulating fluctuation, and requiring the tactus eruditus to solve the difficulty. Manipulation is quite painless: the integument, if not hypertrophied, is pale, slack, and freely moveable on the tumour; and this, too, is loose upon the parts beneath, at least in the first instance. When the tumour has been of long duration, and attained to great size, both skin and tumour become more fixed; the former being stretched over, and partly

incorporated with, the bulky mass; and the latter having sent forth its lobules deeply, into the intermuscular spaces. Growth is slow and steady; more rapid than that of any other simple tumour, yet slower than that of any malignant swelling for which it is likely to be mistaken. The most common sites are the thighs, shoulders, neck, back, abdominal parietes, and labia pudenda. Sometimes the tumour is of a pedunculated character, projecting from the general surface, and attached by a narrow neck.

The swelling for which it is most apt to be mistaken, is abscess. The tactile examination usually suffices for the experienced. Besides, there is the history of the case; all signs were wanting of inflammatory excitement, during its progress; the skin is pale and loose; there is no œdematous swelling around, unless the size of the tumour should interfere with the lymphatic return: and this it seldom does, usually occurring on the outside of the limbs.

It is in vain to attempt discussion of this tumour; nothing but harm can ensue; enlargement, adhesion, degeneration. A seton has been used; in the hope of exciting disintegration by thorough suppuration. But the result will prove unsatisfactory; and besides, the procedure is fully as severe as the appropriate treatment, extirpation. This should not be long delayed; for although the fatty is among the most simple of tumours, and little prone to change either in structure or in tendency, yet examples are not wanting of stimulation, long continued, having succeeded in effecting complete medullary and malignant degeneration. Besides, the lobules are apt to extend deeply, as already stated; and, even in the original state, the operation may thus be rendered difficult and dangerous. It is good surgery to advise and execute extirpation by the knife, so soon as we are satisfied of the existence of such a tumour, and the patient has been convinced of the expediency of the operation. A free incision having been made through the integuments and cyst, the elastic tumour starts outwards; and no regular dissection is required, as in other tumours; the fingers, aided by an occasional touch of the knife, usually suffice for removal. After incision, evulsion is a more appropriate term for the proceedings, than extirpation or dissection; unless malapraxis have produced adhesion and incorporation with the adjoining parts.

III. THE FIBROUS TUMOUR.—This is the most dense and firm of all simple tumours of the soft parts; composed chiefly of dense ligamentous or fibrous tissue, irregularly interlaced, and containing fibrinous matter, also of great density, in the interstices. The shape is usually globular, and the surface frequently nodulated. The investing cyst is thick and strong, presenting a smooth surface to the tumour, with which it is slightly connected. Vascularity is scarcely greater than that of the adipose; and both forms of tumour are inferior in this respect to the simple sarcoma. The vascularity of the fibrous tumours is said to depend chiefly on veins, arterial vessels being with difficulty traced into their proper tissue. Sometimes their density is so great as to be almost cartilaginous. They are perfectly circumscribed, moveable, and independent of the tissue in which they appear. They may occur in any situation; but are most frequently found in the neck, in the vicinity of

the mammary and parotid glands, and connected with the uterus. They are painless; slower in growth than any other tumour, and the least liable to change in structure or tendency. They are consequently inconvenient only by their bulk; and by the uneasy sensations, and interruption to function, which their compression of neighbouring parts may occasion.

Lately, it has been asserted that the fibrous tumour never degenerates; and that, as it is also of slow growth, it need not be made the subject of operation, early, or at all. This, however, seems to be an exaggeration of the fact. It is slow of growth as a fibrous tumour, and is little prone to abandon that character; but, age of the patient, and accidents of the system, duration of the tumour, and its frequent stimulation, may force even the fibrous structure into degeneracy of action and rapidity of untoward advancement. Let extirpation be had recourse to, while the tumour is yet small, simple, and free. No hope need be entertained from absorption.

IV. THE CYSTIC TUMOUR, or CYSTO-SARCOMA.—Many of the malignant tumours contain cysts; but to these this term does not apply. Cysto-sarcoma designates a tumour partly composed of solid structure, partly of cysts or cavities variously occupied. The solid structure, or stroma, is of a simple and non-malignant kind; analogous to that either of the simple sarcoma, or of the fibrous tumour. The cysts are not mere vacant spaces, caused by breaking down of the solid matter, as often happens in the malignant formations; but are part of the original structure, lined with a distinct secreting membrane, and occupied by contents of various kinds. These are usually more or less fluid; sometimes a clear, glairy liquid; sometimes a gelatinous, pale mass, of semi-solid consistence, elastic, and projecting beyond the level of the cut cyst on a section being made; sometimes solid, consisting of a fibrinous deposit, organized very imperfectly if at all; sometimes of an atheromatous, or pappy consistence, as in many encysted tumours. Sometimes, but more rarely, a dark fluid, like printer's ink, is contained; sometimes, blood is mingled with the contents, either in the solid or in the coagulated form; but such appearances are usually indicative of, and coeval with, degeneration of the tumour towards malignancy of structure and action. Sometimes the cysts are numerous and small; in other cases, they are few and of large size. Sometimes they are single in themselves; sometimes many smaller cells are contained within a parent, attached by narrow peduncles. In the latter case, the tumour has been called cysto-sarcoma proliferum; in the former, cysto-sarcoma simplex.

Müller has described a third variety, which he terms cysto-sarcoma phyllodes. "The tumour forms a large firm mass, with a more or less uneven surface. The fibrous substance which constitutes a greater part of it, is of a grayish white colour, extremely hard, and as firm as fibro-cartilage. Large portions of the tumour are made up entirely of this mass, but in some parts are cavities or clefts not lined with a distinct membrane. (An exception to the general rule in cystic tumours.) These cavities contain but little fluid; for either their parietes, which are hard like fibro-cartilage, and finely polished, lie in close apposition with each other, or a number, of firm, irregular laminæ sprout from the

mass, and form the walls of fissures; or excrescences of a foliated or wart-like form sprout from the bottom of the cavities, and fill up their interior. These excrescences are perfectly smooth on their surface, and never contain cysts or cells. The laminæ lie very irregularly, and project into the cavities and fissures like the folds of the psalterium in the interior of the third stomach of ruminant animals. Sometimes the laminæ are but small, and the warty excrescences from the cysts very large, while in other instances both are greatly developed."

The cystic tumour may occur in any situation; but is most frequently found in the generative organs; in the testicle; in the female breast; and in the ovaries, or their immediate vicinity. The tumours are of no certain shape; but approach more nearly and frequently to the globular than to any other form. The integuments are not implicated in the morbid structure; yet usually show more or less of discolouration, especially at the points where the cysts are placed. The feel is unequal; at the cysts, there is fluctuation, more or less distinct; the more distinct, the larger the cyst and the more fluid the contents; at the solid parts the handling is as of the simple sarcoma, or as of a fibrous formation.

The tumour is non-malignant; but is prone to degenerate; no doubt, in consequence of the independent secretive power which the cysts possess, and which may at any time take on a perverted and depraved action. Hence, there can be little doubt as to the propriety of early removal by operation.

The following tumours scarcely deserve distinct places in the classification; they not only occur seldom, but also still more rarely as distinct formations:—

(a.) *The Cartilaginous Tumour*.—Cartilaginous formation is rare in the soft tissues; very seldom occurring as a distinct structure; sometimes studding the interior of the simple and of the fibrous tumours. The nature and tendency are simple; yet degeneration is possible while discussion is impossible; and therefore early extirpation is expedient.

(b.) *The Calcareous Tumour*, is more frequent, yet still of rare occurrence. It is most frequently found in the face and neck—especially in the former situation, in the vicinity of the parotid gland. In most cases, the stroma of the earthy deposit would seem to be the hypertrophied texture of a lymphatic gland. The tumour is superficial, loose, painless, hard, of slow growth and small size; its surface is generally unequal. It is inconvenient, simply by its bulk and position; and has but little tendency to degenerate. Absorption, however, is hopeless; and early removal is expedient. From the circumscribed form, small size, and slightness of adhesion, the dissection is easy; little more than simple incision is required.

Sometimes calcareous formations are found in the ovary, and in the testicle.

(c.) *The Osseous Tumour*, like the cartilaginous, very rarely occurs by itself, but is sometimes found in the interior of the sarcomatous

formations. The simple, adipose, and fibrous, all occasionally expose bony points in their section. Small tumours, apparently of a true bony character, are sometimes found in the vicinity of the uterus, and attached to that organ.

(d.) *Hydatids* occasionally form in the general cellular tissue of soft parts, and in the interior of secreting organs, such as the mamma. They are also found in the cancellous texture of bones. They vary in size and number, constituting a tumour of unequal outline, soft, and fluctuating. The cure is by extirpation; if of small size, and superficial, destruction by escharotics may suffice.

V. THE TUBERCULAR OR SCROFULOUS TUMOUR.—This tumour, as already stated, may be regarded as occupying a middle place between the simple and malignant formations. The constitutional vice is that of scrofula. The peculiar deposit is of tubercle; in the first instance, probably interstitial; subsequently accumulating, by apposition, in mass. It may occur in the ordinary cellular tissue; its most frequent site is the glandular organs, both lymphatic and secreting, but especially in the former; in the latter, its characters are usually most distinct as a genuine tumour. In the testicle it is very common. The nature and progress of the deposit is similar to what was formerly described, when treating of scrofula. The tubercle at first crude, and perhaps remaining so for a long period, either stationary, or gradually increasing in bulk; then suppuration, slow and imperfect; involvement of the integuments; opening and discharge; and, lastly, the ordinary characters of the scrofulous sore presented. Section of the mass shows a homogeneous structure, whitish, soft, granular, not truly organized, devoid of vascularity; sometimes surrounded by a very distinct cyst; sometimes not, the formation having been rather by interstitial deposit; in some parts, probably, broken down, and mingled with a non-laudable purulent formation.

This tumour, in its early stage, is capable of removal by absorption; under the ordinary means, but especially by the use of iodine and its preparations, both externally and inwardly. Failing this, it may be got rid of by central suppuration and disintegration; often a spontaneous process; and one which can be artificially induced, as well as accelerated and made more effective when of spontaneous occurrence. Not unfrequently, the suppuration is but partial; a portion of the morbid structure has come away, but the rest remains in an indolent state, tending neither to efficient reproduction nor to further decay. Under such circumstances, the potassa fusa is highly available; a portion being thrust into the centre, and throughout the tumour in various directions; not so much with the intention of converting the morbid structure into an immediate slough, as of ensuring its thorough softening and disintegration. Subsequently, uniform and sustained pressure is of use, in favouring consolidation of the chasm, and obtaining a firm and sound cicatrix. It need scarcely be added, that constitutional management, with a view to removal of the general disorder which has led to the

local change, is of paramount importance. And it is also obvious that in consequence of the co-existence, and in most cases the pre-existence as well, of the constitutional vice, no certain immunity from relapse can be predicated from any treatment, however active and suitable, directed against the local malady alone.

Extirpation of lymphatic ganglia, as formerly stated, is never warrantable, when the subject of either simple or tubercular enlargement. Discussion or suppuration suffice for the cure. In the secreting glands, however, it is sometimes otherwise; more especially in the testicle. Here, a scrofulous tumour occasionally resists the ordinary modes of treatment; and, hectic having set in, amputation of the diseased part is demanded.

Scrofula is very frequent in this country; so is one of its local signs, the scrofulous tumour. It is known by the usual characteristics of the tubercular deposit; congested and discoloured integument, and indurated enlargement beneath, with the general signs of the cachexy; afterwards, more plainly by the scrofulous ulcer and discharge.

It has been said, that the scrofulous diathesis is incompatible with the cancerous. If such be the case, this is the only circumstance which can be adduced in favour of the scrofulous tumour.

The Malignant Tumours.

We now leave simplicity and analogy of structure, with benignity of action, wholly behind; and come to the heterologous formations truly malignant. These change the original texture of the part quite; invade the surrounding parts, converting them into a similar structure with themselves; and extend not only by continuity, but remotely, by the lymphatics; the lymphatic ganglia enlarging, not so as to constitute a mere hypertrophy, but a production of the same kind as the original tumour; and the system is involved in a cachexy, too often insuperable, whereby reproduction of the disease is rendered at least probable.

VI. THE MEDULLARY TUMOUR.—The Encephaloid, the Medullary Sarcoma, the Cephaloma. There are other synonymes, but these are the most frequently employed; terms originating in the likeness which the morbid product bears to the brain, in colour, texture, and consistence; and yet the resemblance is far from being so close as to warrant the appellative of an analogous formation. The tumour may be originally of this kind; or a growth, originally simple, may have degenerated, and assumed the medullary character. And it is to be remembered, that when any tumour does degenerate into malignancy, it is generally the medullary structure and character which it assumes.

This tumour is highly vascular; supplied and intersected by large veins; and also not without its arterial nourishment. The simple tumours are all but sparingly vascular; the simple sarcoma is moderately supplied with blood-vessels, and the adipose is less, and the fibrous less still; the tubercular deposit is in itself non-vascular, and the cellular stroma with which it may be connected is not likely to be increased in

its vascularity. In this respect, the malignant formations differ prominently from the benign; they are all freely supplied with blood-vessels; and the medullary particularly so. Indeed, in regard to tumours in general, there is good reason to believe, that the less the vascularity, not only the less rapid is the growth, but the less the tendency to degenerate by assumed depravity of action.

Section of a medullary mass displays a consistence, colour, and general aspect of structure, like that of brain; its vascularity is shown by the open mouths of large veins, and minor red points as seen in sections of brain. The arrangement of the morbid mass is generally even and smooth; sometimes, however, it presents the waving and irregular appearance of convolutions, as in the cerebral hemispheres. Microscopically, the tumour is found to consist, partly "of a medullary mass, composed of globules and other corpuscles; partly of a tissue made up of delicate fibres, in the meshes of which the medullary portion is contained."* Sometimes it is surrounded by a cyst; if so, the cyst is usually imperfect, at one or more points, and there the tumour has plainly increased more rapidly than elsewhere. More frequently there is no envelope; the surrounding textures having not been pushed aside, but drawn into the structural change. It is not unusual to find one or more dense fibrous bands intersecting the mass; but these are not to be regarded as a part of the original tumour; they are accidental, and owe their existence to the approach and union of two or more medullary masses, between which a part of the original textures, much condensed, still remains free from the medullary change. At first the mass is homogeneous. But after a time, softening occurs, at one or more points, by imperfect suppuration; and there the consistence and colour resemble somewhat those of cream; not unfrequently, however, of a much darker hue, by admixture of blood. Blood also is often found in masses, not fluid but coagulated; sometimes it is infiltrated diffusely throughout the morbid structure; signs always of evil omen, as indicative of much malignancy, and an almost certainty of return.

In tumours of any considerable duration, cavities may always be expected, more or less numerous. They are of two kinds; mere spaces, formed by softening of the medullary substance, and occupied by this softened matter variously mixed with blood, solid or liquid; or true cysts, lined by a secreting membrane, and filled by blood, by dark fluid, or by soft medullary matter. When the latter are found, the probability is, that the tumour has been originally of the simply cystic kind; that it has degenerated; and that these cysts are truly remains of the original and non-malignant structure, not yet annihilated. In other words, it is believed, that cysts lined by a secreting membrane do not enter into the original structure of a medullary tumour. All the simple tumours are liable to degenerate into the medullary; the cystic the most prone; the fibrous the least. And when a section is made during the period of transition, part of the original structure is found, gradually and insensibly passing into that which has already assumed the medullary characters.

* Muller.

So long as the tumour is invested by the integument, entire, it is said to be *occult*; when the skin has given way, and the morbid structure consequently comes to be exposed, it is said to be in the *open* state. This opening is effected by inflammation and ulceration of the skin, or other intervening texture, at the most prominent point of the swelling. In consequence of the elasticity of the morbid structure, a projection of the mass immediately takes place; and this is increased by rapid growth at this point, where resistance has been removed. A fungus is speedily established; much of the same texture as the general tumour; but softer, and darker in colour, in consequence of atmospheric influence and admixture with extravasated blood. The surrounding integuments are without reparative effort; ulceration extends in them; and a fœtid, bloody, thin fluid is profusely discharged. Sometimes the fungus sloughs, or crumbles away by softening and disintegration: it is, however, quickly reproduced. Not unfrequently, a blood-vessel, probably one of the large veins, is opened into; and profuse hemorrhage results, of a dark unwholesome kind; fearfully aggravating the prostration of system, which the previous state of the tumour had already begun.

In the open state, the nature of the formation is sufficiently plain; in the occult, diagnosis is not always readily effected. It is important, therefore, to be aware of the external character, and other signs of the existence of the tumour, from even its earliest formation. Its growth is peculiar; being the most rapid of all tumours; in a few months or even weeks, the size may have become truly enormous; and very frequently a marked increase, day by day, may be readily observed. A fallacy, however, may occur at this point. A simple sarcoma, deeply seated, and tightly bound by fibrous investment, may simulate some of the characters of the occult medullary tumour very closely; the surgeon, in doubt, manipulates it freely, and, for some time, perhaps, daily; he thinks he observes a marked and rapid increase of bulk, and by measurement or otherwise he may ascertain that such is actually the case. This last sign he may think conclusive, as to the medullary nature of the tumour; and he may take his measures of treatment, according to that conviction. And yet, had he waited for a few days more, abstaining the meanwhile from further handling of the part, he would have found subsidence of the increase in swelling, the tumour regaining its former dimensions; the temporary enlargement having resulted from the common products of simple vascular excitement, the consequence of manipulation.

The skin investing the tumour is pale, like that of a diseased and chronic articulation; and usually shows many large veins coursing beneath it. Sometimes the skin is of a brownish hue. At first, it is moveable on the tumour; afterwards intimately incorporated therewith. The growth itself is not circumscribed and moveable, as the simple formations, but fixed and diffused into the surrounding parts. To the touch a sense of great elasticity is imparted; different from the fluctuation of chronic abscess, and different also from the semi-fluctuation which the fatty tumour exhibits, yet somewhat resembling both; inso-much that it is not without the tactus eruditus—as well as attention to

the other signs—that the distinction can always be unerringly made. Occasionally even the most experienced cannot be assured, until after an exploratory puncture. Perhaps they expected pus; but nothing save blood escapes, and that profusely; vascularity and elasticity are demonstrated, not fluctuation. Pain is almost always considerable; often severe and shooting. In some cases it is at first absent; and then the tumour is usually slow of growth; but when it enlarges in the ordinary manner, as it soon does, the pain becomes developed, and continues. The patient is obviously cachectic; and bears in his countenance a plain token of a formidable disease; the features are shrunk and anxious, the hue is sallow, emaciation is begun, the functions of animal life are all disturbed, and hectic is setting in.

While carcinoma and cancer are comparatively limited to advanced years, this disease is found to occur more frequently in the young; children and adolescents are the ordinary patients. It may occur in any texture; but is most frequent in the orbit, testicle, mamma, joints, internal viscera, and lymphatic ganglia. In the two last situations, the formation is usually of a secondary character; that is, following on the appearance, or perhaps the removal by operation, of a medullary tumour elsewhere. For, as already observed, the disease extends not only by contiguity, involving the adjacent tissues, but also remotely by the lymphatics; and besides, the system being involved—probably as the original part of the malady—there is the same predisposition to the morbid deposit in one part as in another. Sometimes the veins in the neighbourhood have been found filled with the medullary substance; but whether by simple extension of the tumour, or by conveyance of the deposit, is a matter of doubt. Pressure on veins and lymphatics occasions œdema of the parts beneath; compression of adjoining nerves creates intense pain, in addition to that which already existed as an inherent characteristic of the tumour. At first the nervous trunks are expanded and stretched over the growth; ultimately they are involved in its structure. Occasionally, the disease has been found to extend by means of a nervous trunk; a tumour growing thereon, at some distance from the original formation, and precisely of the same character; a medullary tumour involving the sciatic nerve, for example, has been followed by a growth of the same kind occurring in the popliteal.

It is plain that the only chance of cure is by extirpation, at a comparatively early period; when the tumour is small, not deeply or widely connected, the glands free, and the system making but little show of complaint. The dissection must be carefully and leisurely conducted, to ensure entire removal of the whole diseased structure; the slightest portion left will certainly cause reproduction, rapidly, and of a worse tumour than the primary. Smart hemorrhage is to be expected; not only from arterial branches, increased in size and activity, but also by oozing from the general surface. The muscles are usually of a pale and flabby character; sometimes at certain points, near the tumour, they are the seat of dark discolouration, as if by infiltration of blood. There is also a greater tendency to secondary hemorrhage, than after simple wounds.

The operation having been suitably performed, the question of prog-

nosis arises, as regards the probability of return; a question always of much doubt and difficulty; and never to be answered decidedly in the affirmative. This tumour, like the tubercular, is in the great majority of cases to be viewed not so much as a disease in itself, as a symptom of a constitutional vice, from which other tumours may arise of a similar nature, in the vicinity of the first formed, or elsewhere. In both cases there is a cachexy, constituting the major part of the evil; that of tubercle is but little amenable to treatment; the malignant and medullary is still less so. And unless that cachexy be removed—an object in this disease unattainable—there can be no certain immunity from return. Our duty is very plain; to operate, carefully, in those cases of recent and limited tumour, the circumstances of which seem favourable to success; to refrain from operation in those advanced cases, where not only deep and important parts are involved, but where both the lymphatic and general systems are plainly implicated, and when consequently reproduction is certain; and in all cases to express our prognosis in the most guarded terms. According to my experience, the situations most favourable to non-return, after timeous operation, are the orbit and testicle; especially the latter.

Reproduction occurs either in the original site or elsewhere. A medullary tumour having been removed from a lower limb, for example, we apprehend return not in the stump alone, nor in the groin, nor in any part of the external surface; but are anxious in regard to symptoms of internal mischief, by formation of medullary masses in the liver, kidneys, or lungs. This internal site of reproduction is perhaps the most common; not unfrequently, the return is on the surface as well. As already stated, bloody masses and infiltrations, shown in a section of the original tumour, are declared by experience to be ominous of return. And under whatever circumstances the return does take place in the original site, the secondary formation almost invariably shows an aggravation of progress and malignancy; probably in consequence of increase of the cachexy, which the depressing effect of the previous operation has induced.

Molluscous tumours of and beneath the skin, occurring in great numbers over the general surface, not unfrequently present all the characters of the medullary formation. Such cases are obviously hopeless. Operation is unwarrantable, and we must content ourselves with palliation.

VII. CARCINOMA.—This is the occult malignant tumour, whose open condition is termed *Cancer*. Scirrhus is a synonyme; but is also a term which has been so much abused, that it is well to exclude it altogether from our nomenclature. At one time, every hard swelling was termed a scirrhus, whether carcinomatous or fibrous, simple or malignant; and the inevitable result was much confusion and error, in both the pathology and treatment of tumours.

Like the medullary, this tumour may be either secondary or original. Much more frequently it is the former; secondary formations, by degeneracy, being usually medullary, as already stated.

When primary, as it generally is, carcinoma has a small, firm origin, and steadily increases; usually with much pain from the beginning, of a sharp and shooting kind. The hardness to the touch, is greater than

in any other tumour, even the fibrous; it is stone-like. Weight also is great, in proportion to the bulk. The form is not globular and distinct, like that of the fibrous; but flattish, irregular, and gradually lost in the surrounding texture; at least without any abrupt or distinct margin of separation. The growth of the tumour is not rapid; greater than that of the fibrous tumour, but less than that of the other simple formations, and infinitely slower than that of the medullary. And it may be stated as a general rule, that the older the patient, the slower the growth of the tumour. In the comparatively young—say forty—months may suffice for far advancement, and in the old—say seventy—years may have passed away, with a tumour yet hard, small, occult, and but little painful. When the tumour forms in the substance of an organ, as the mamma, the original texture may seem to grow smaller as it grows hard; the tumour slowly increases, and at the same time the normal texture around shrinks by interstitial absorption. As it approaches the surface, the intervening textures are involved in the morbid structure, and the skin is ultimately incorporated, becoming dark-coloured, dense, depressed, and adherent; and this usually happens at a comparatively early stage. At first, the tumour is moveable; but ultimately, by incorporation with neighbouring parts—skin superficially, and muscle beneath—it becomes fixed. By gliding with the muscle, however, to which it is attached, over the subjacent bone, mobility may be simulated; a carcinomatous mamma, for example, fixed deeply in the pectoral muscle, may, from this cause, seem wholly superficial to it; and careful examination is required for accurate diagnosis in this respect. Sometimes the carcinomatous passes into the medullary, either wholly, or in part; then the characters of the former are merged in those of the latter; the tumour becomes soft, prominent, and elastic, growth is rapid, and the size may become great.

A cachexy, similar to that of the medullary tumour, attends on carcinoma, marked by the same symptoms; but is usually less intense in its development, though equally incapable of cure. The disease seldom makes its appearance until mature age; rarely before thirty; more frequently after at least ten years more have elapsed. Females are more liable to its inroads than males; and the females who have borne no children are more likely to suffer than those who have been often pregnant. The mamma, uterus, testicle, lip, skin, and mucous surfaces, are the most frequent sites; and most especially the first.

It is probable that the origin of the diseased formation is like that of most other tumours, interstitial; that the natural structure of the part is displaced and expanded, by carcinomatous deposit in the interstices. So soon, however, as the formation and growth of this tumour have been fairly established, there is no longer displacement, but involvement of adjoining parts; all tissues, however dissimilar, are converted into the same degenerate and evil structure. On a section being made, the tumour is declared to be of great density; in this respect almost equal to cartilage: it “cries under the knife,” cutting like an unripe potato or pear. It is found to consist of two distinct portions; an interlacement of fibrous matter, in the interstices of which a granular substance is laid, of a gray colour. The general aspect of the section is dense,

fibrous, and gray. In the mamma, whitish filaments are sometimes seen, hollow, and containing a yellowish matter; they are supposed to be lactiferous tubes and lymphatics, not yet involved wholly in the degeneration. The fibrous arrangement is most distinctly seen, after removal of the gray granular matter, by scraping or maceration; and the microscope shows the structure to be truly fibrous. The gray matter, microscopically, is found to consist of nucleated cells and molecules, chiefly globular, but some caudate or spindle-shaped. Whether this "*materies morbi*" is simply deposited from the blood, or is the result of extravascular formation, seems yet undetermined. When the carcinoma is original, it is seldom surrounded by any cyst; but extends itself, diffusedly, as if by roots, into the surrounding texture. When it is of secondary formation, the cyst of the originally simple mass for sometime remains uninvolved, but ultimately disappears in the general invasion of structure.

Several varieties of this tumour have been given by the Pathologist; the more prominent are the Carcinoma reticulare, and the Carcinoma alveolare or Colloid tumour. In the former, the fibrous interlacement is peculiarly distinct, giving a reticular appearance to the mass, very obvious to the unassisted eye. The latter is most frequent in internal organs; more especially the stomach; the basis of the structure is composed of numerous white fibres and laminae, crossing each other in all directions, and having their interspaces occupied by cells, varying in size from that of a grain of sand to that of a very large pea; some closed, but many communicating with each other; containing a very viscous, clear, perfectly transparent jelly.

Cancer denotes the open or ulcerated condition of the carcinomatous tumour. It may also commence as an ulcer, without any previous solid growth; as happens, not unfrequently, in the mucous membrane and skin.

The tumour, having approached the surface, softens in some parts of its interior; the carcinomatous texture becoming broken down, pulpy, and often mixed with blood. This process of softening and disintegration—the result, doubtless, of an inflammatory process kindled in the morbid structure—spreads outwards; and, by its agency, an integumental breach is in due time effected. There is no sprouting fungus, as in the medullary tumour; for the morbid structure is devoid of elasticity, as well as much less rapid in its production. The breach widens and deepens; the carcinomatous texture, where exposed, continues to crumble down; and the reparative efforts which are occasionally made, show only a few, straggling, hard granulations, which quickly fall away under re-accession of the ulcerative action. While, however, reparative efforts are few, and wholly ineffectual, reproduction, as regards the diseased structure, is constant and efficient. Portions of the tumour sometimes come away, not in particles, but in masses; but generally there is little or no diminution of the tumour, or abatement of the disease, in consequence; the place is soon occupied by fresh formation, and the onward progress is unchecked. Sometimes, however, the ulceration advances rapidly, without reproduction; forming a deep and cavernous excavation.

The characters of the cancerous ulcer are very peculiar; and, once seen, can scarcely again be mistaken. The edges are hard, serrated, and everted; the eversion complete; the hardness, as that of cartilage; sometimes it is of a red angry hue. The surface discloses the morbid structure, soft, and in process of ulceration; studded, at some points, more especially near the margin, with the futile granulations already spoken of. The discharge is thin, bloody, and profuse; possessed of an intensely fœtid odour, so peculiar as generally to be held of a pathognomonic character. Pain is burning and constant. There is no power of cleaning this sore; under every application, it looks foul and loathsome. Sometimes it is covered by a black or tawny slough. Not unfrequently, a dark bloody oozing takes place, from some part of the sore, perhaps on separation of such a slough; sometimes there is smart hemorrhage.

One peculiarity of the carcinoma and cancer is, that the disease is especially prone to extend by the lymphatics. Sharp, stinging pains are felt, in the direction of the main lymphatics and their ganglia; shadows of the coming event. Then hard and tender cords are observed, extending from the tumour on the lymphatic aspect; sometimes with small indurations by their side. These cords may extend, unbroken, to the ganglia—as in the axilla; and there a second tumour, in all respects like to the first, only of more rapid growth, and more distressful in its symptoms, begins to form. Or, this may take place with few or none of these premonitory symptoms; without cord or kernel in the intervening space. The œdema which occurs in the limb, whose lymphatics have become thus obstructed, is great; the pain is constant, severe, and sometimes excruciating. So much so, that often the patient's attention is entirely diverted from the original malady, and fixed on the part which has become so swollen and painful. The cachectic state of system becomes more and more aggravated, sleep is gone; appetite fails; emaciation is great, and still increasing; the sallowness, wan, cadaverous expression of face become more marked; the whole frame grows bloodless; a malignant hectic, as it may be termed, is established; and life is gradually exhausted, in much physical misery. Sometimes the fatal issue is accelerated by the accession of an internal disorder, structurally unconnected with the cancer. In cancer of the mamma, for example, pleurisy and effusion often constitute the immediate cause of death.

The period of lymphatic invasion varies. Sometimes, at a very early stage of the primary tumour, the secondary formation is begun. In other cases, months, and almost years may have elapsed, without as yet any affection of the lymphatics being apparent; but this is as the exception to the general rule. It is seldom that the stage of cancer has been of long duration, without secondary formation having been at least apparent; the ganglia, which seemed to remain sound during the occult stage, generally soon give way when the open condition has been established. Sometimes, the secondary lymphatic tumour is not carcinomatous, but medullary.

During the cancerous progress, a peculiar fragility of the skeleton is liable to occur; untowardly complicating the case. On some slight

exertion, as turning in bed, walking across the room, or rising up suddenly; or in consequence of some slight injury, by blow or fall—a bone breaks. The patient becomes bedridden in consequence; by the confinement, the cachexy is increased; and the fatal issue is accelerated. Sometimes the bone re-unites in the ordinary way, by callus, under the ordinary treatment; and the patient temporarily recovers, from the complication. Sometimes, there is no union at all. Perhaps, more frequently, there is a reproductive effort, but not of callus; a depraved deposit takes place; and, at the site of the fracture, a new carcinoma is soon in progress.

By most authorities it is agreed, that the carcinomatous disease—or diathesis, as it may well be termed—is hereditary; not invariably; but capable of being transmitted from parent to child. The question as to its power of reproduction by contagion, is still an open one; authority seeming to lean towards granting the possibility of the disease being so produced, but denying that it frequently is so. The predisposing cause of the malady is, doubtless, that constitutional vice, which has not yet been satisfactorily explained in its origin, but which is most obviously present in all advanced cases, and has been termed the carcinomatous diathesis. The exciting cause is injury, or stimulation of a part, with a system so contaminated; and with, or without, the previous existence of simple tumour. The scrotum, habitually irritated by soot and filth, becomes the seat of the carcinomatous structure, and cancerous ulceration; a prolabium, in advanced years, repeatedly injured, undergoes a similar change. On the other hand, a tumour, originally simple, degenerates in consequence of frequent or habitual injury, applied in a vain endeavour to obtain discussion; and, in its degeneracy, it may assume the structure of carcinoma. And as a simple tumour may thus change into a malignant—so an ulcer, as in the prolabium, originally simple, and disposed to heal, kindly and permanently, may from repeated irritation degenerate into cancer.

Treatment.—It is hopeless, and worse than useless, to attempt discussion of the carcinoma. The tumour will only have its energies further roused, and proceed more rapidly to its fatal issue. Besides, valuable time will have been sadly mis-spent, and opportunity lost of affording the most favourable chance of cure—by timely extirpation. Leeching, rest, and fomentation, may palliate the symptoms, and retard the growth; yet they do nothing towards actual cure; and are reprehensible as consumers of valuable tissue. But, as formerly stated, much benefit will occasionally result from discussion of the common products of the sub-inflammatory process, which may have taken place around, and on which much of the apparent bulk of the tumour may depend. Let this attempt, however, be cautiously conducted; so as to stimulate absorption, and nothing more. For, should vascular excitement, with increase of deposit, whether in or out of the tumour, ensue, nothing but harm can follow. If it be true, as advocated by Dr. Hodgkin and others, that the elementary structure of such growths consists of minute cells, and that those are capable of being infiltrated into surrounding textures, during excitement in or around the tumour, it becomes very plain how perilous must be the induction of such excite-

On the structure of the carcinoma of the scrotum. See the original paper in the London Medical and Surgical Journal, Jan 1837, 231.

ment by stimulation, in any way, or with whatever object in view ; the cells are lodged, perhaps, in numbers, at a distance from the main tumour ; and, on the removal of that, even by wide incision, sundry others quickly form to take its place. This theory would seem to be favoured by the fact, that, after removal of carcinoma by operation, especially from the breast, the usual mode of return, at the original site, is not by the formation of a large tumour as before ; but by the appearance of numerous, small, stony, and painful kernels, so superficial as to seem to be integumentary ; after a time uniting to form a confluent mass, which ulcerates, and otherwise advances untowardly, as carcinoma usually does.

Is there a specific for any disease ? is a question which can hardly be answered in the affirmative. Is there a specific for carcinoma or cancer ? is a question which we need not hesitate to answer with a decided negative. Many have been declared, and many have been tried as such ; yet all with but one issue—failure. Some, comparatively harmless, failing in the main object, yet may have palliated suffering, and even somewhat delayed advancement. But the majority, of a stimulant nature, favoured the tumour's increase, bore further down the system, and rendered death both more early and more wretched.

The only chance of cure is by direct, early, and thorough removal of the morbid structure ; and this may be effected by cautery, or by incision. The actual cautery has been employed with this view ; but is now laid aside. Potential cauteries—the potassa fusa, the mineral acids, the chloride of zinc, arsenic—have held their place longer, and with a better prospect of continuance of tenure ; but yet must give way, on the score of efficiency, to the knife. Their present place, in good surgery, is not as the main agents of removal, but only as auxiliaries. When the knife has taken away as much as it can, and a suspected portion yet remains, inaccessible to its edge, the cautery is then most useful. Also, in cases of cancerous ulcer, or ulcer of a suspicious kind, very superficial, and of no great extent—as on the prolabium, or on a portion of integument—the potential cautery may itself suffice, when freely applied.

Excision is infinitely the preferable mode of removal, in the majority of cases ; by a free, cautious, and wide dissection. Care being taken, that not only the whole of the morbid structure is taken away, but also that a border of apparently sound texture goes with it, in order, if possible, to make sure that none of the cellular or other germs of the disease are left behind, in the interstices of the adjoining textures. In regard to such dissection, it is useful to remember, that dense fibrous tissue resists the invasion of carcinoma longer than any other texture ; and that, consequently, the incisions need be less free, beyond that tissue, even where it is partially incorporated with the tumour. But yet, in all cases, the propriety is obvious of approaching error on the safer side ; rather sacrificing texture unnecessarily, than encountering the risk of leaving a nucleus of reproduction behind.

Some, taking an abstract view of the subject, entertain a question as to the expediency of operating at all in carcinoma ; inclining to regard the affection as wholly constitutional, and not to be eradicated, or even

restrained, by removal of only a local portion of it. This view we do not propose to consider; but, with the majority of the profession, granting that the disease is constitutional as well as local, and that in most cases it shows more of the former than of the latter character; granting that very many cases occur—doubtless the majority—in which operation is inexpedient; and granting that in all cases, looking to the constitutional vice, we can never be certain of immunity from return, and must invariably issue a guarded prognosis accordingly:—still, we are of opinion, that there are cases, often presenting themselves to the surgeon in extensive practice, in which it is his bounden duty, by operation, to afford his patient the chance either of a definite and radical cure, or at least of a postponement and palliation of the malady. Such cases are those in which the tumour is yet small, and comparatively circumscribed; the lymphatics unchanged, either in the immediate vicinity or at a distance; the integuments and muscles free from incorporation; the patient not far advanced in years; and the cachexy as yet but little indicated, if at all. On the other hand, affection of the lymphatics, already begun, even though to a trifling extent, contra-indicates operation; for, according to experience, reproduction is sure to follow, even in those of such cases in which the surgeon is certain that not only the tumour itself, but the adjoining changed structure as well, lymphatic or not, has been thoroughly taken away. Incorporated skin and muscle can be removed, by wide and free incision; yet it is most difficult, if not impossible, to say that what is left is sound, free from lodgement of the *materies morbi* already in its texture; and, in such cases, experience again speaks loudly in favour of return. In the very old, a carcinoma may exist for years, in a latent or indolent condition; still occult, and still of small size and circumscribed: the seat of little uneasiness, and attended with but little disorder of the system; and the patient may die, ultimately, of disease to all appearance totally unconnected with the carcinoma. Under such circumstances, operation is withheld; the tumour is left undisturbed, and guarded carefully from excitement. But while thus, in the patient of seventy, the progress of the tumour is slow, and the indications of cachexy weak or apparently absent—the opposite obtains in regard to the patient of forty. And when, at such age, a tumour is advancing rapidly, with a marked cachexy at the same time consuming the general frame, it is prudent to abstain from the knife, even though the lymphatic system seem as yet wholly uninvolved; for, in such cases, the probability of return is extremely great; the disease is not delayed by the operation, but truly undergoes an exacerbation. And thus we see, that extreme activity of the disease in the comparatively young, and extreme indolence in the aged, both alike contra-indicate operation. It may also be observed, that, *cæteris paribus*, return is more probable in the case of the open tumour, than of the occult.

In those cases in which there is freeness of integument, and laxity of all the surrounding textures, it is well to conduct the incisions, and subsequent treatment, so as to favour adhesion of the wound, and mobility of the cicatrix; for, experience has declared such a state of matters favourable to immunity from return; while tedious suppuration

and granulation, resulting in a tight, firm, adherent cicatrix, strained by each movement of the part, have an opposite tendency. All irritation of the cicatrix, of whatever kind that may be, should of course be carefully avoided.

An important question arises, whether, after thorough removal of the apparent local disease, by operation, we have any means of staying, or altogether removing, the constitutional vice; and so securing a permanent cure, by immunity from return. It is to be feared, that such a question can as yet only be answered in the negative. The conium has long enjoyed a certain reputation as possessed of some such virtue; and by some, as Lisfranc, it is trusted in, and administered accordingly. Without much faith in its efficacy, we would still recommend its being made trial of; in doses of a grain, night and morning, gradually increased; but desisted from, at least for a time, should disorder of the digestive organs ensue. It is not likely to do harm otherwise; and it is quite possible that it may sometimes have the happy effect of at least staying the disorder. The terchloride of carbon has lately been announced, as more effectual in this way; one drop in water, thrice daily, and gradually increased. Its advocate, Mr. Tuson,* proposes its external as well as its internal use; and as a means of removing carcinoma and cancer, not of preventing their return. Such efficacy we do not expect from it, or any other medicine; and would be well content, if experience should prove it of any considerable avail in fulfilling only the latter indication. A tonic system of general treatment—preceded, if need be, by alteratives—is certainly indicated, to assist in prevention or arrest of the cachexy's development; and the preparations of iron are usually found suitable. Arsenic, too, may be of service, in this way; not as a specific.

When return has occurred, under what were supposed favourable circumstances, there may come to be a question as to the expediency of farther operation. If the return be in the usual manner, with ulceration and tumour of the cicatrix, numerous superficial nodules around, and obvious involvement of the lymphatics, no good can result from farther interference by the knife. But if the return be by an occult, small, and limited tumour, as sometimes happens, and if the general system be yet comparatively sound—then by a second, and if possible still more careful and complete operation than the first, the remaining chance, even though slight it must be regarded, ought certainly to be afforded to the patient.

In the truly hopeless cases, we content ourselves with palliation. A rigidly spare regimen will be found to do no good by delaying the tumour's growth, while it does much harm by favouring the cachexy's inroad on the general frame; the diet should be simple and non-stimulant, yet nutritive, and rather full than otherwise. By opium and other anodynes, exhibited internally, sleep is procured, and pain of the part and neighbourhood allayed. No stimulants are applied to the tumour; on the contrary, all such are carefully avoided; it is our object locally to soothe; and, for this purpose, opium, belladonna, conium, may be

* *Lancet*, 1037, p. 553.

employed in the form of epithem. In the ulcerated state, much relief is often experienced from the frequent, or even constant, use of a plain and light hemlock poultice. Fœtor is corrected by occasional application of solutions of the chlorides, and by strict attention to cleanliness. The part and its vicinity should be kept as much as possible in a state of rest. Local warmth, by some soft article of clothing, as wool or fur, is also expedient. All friction, with or without stimulant embrocations, is in the highest degree pernicious. Were the disease merely local, pressure might perhaps be cautiously conducted, so as to arrest development of the part, or even to obtain a partial decrease; but, as it is, carcinomatous formation and increase elsewhere, probably in an internal organ, would in all likelihood be the result of the temporary obstruction at the original site of development. And besides, ulceration, by over-excitement, is the usual local effect of pressure on such tumours, even when most carefully employed.

Operation, even in the most hopeless cases, may sometimes be deemed expedient, as a mere palliative. When there is a large and ghastly sore—as of the mamma—pouring out much fœtid, ichorous discharge; and the seat of constant, agonizing pain; conversion of the fœtid and painful ulcer into a comparatively simple wound, may for a time afford very marked relief. The ulcerated part is taken away by rapid dissection; the bleeding points are secured; the wound is left to suppurate, under simple water-dressing; no stimuli are applied; it is seldom that coaptation by suture is practicable, under the circumstances it is scarcely expedient; the wound contracts, and may even heal for a time; degeneration ultimately returns, and its advance is again rapid and untoward; but, during the interval, the patient may have been privileged to enjoy much comparative ease and comfort. In those cases, however—and they are the majority—in which the exhausting shock of the operation, acting on the system, will more than overbalance the contemplated benefit to the part, operation is altogether to be abstained from.

VIII. MELANOSIS.—This may be spurious or true. The former—consisting of mere deposit of carbonaceous matter, perhaps from without, unconnected with other change of structure, and occurring in the internal organs, especially the lungs—belongs to the physician.

With the latter alone we have to do—a disease, however, which occurs much more rarely in man than in the lower animals—particularly the horse. Like other tumours, it is the result of perverted nutrition; a thorough change of structure. It occurs in cellular tissue; more especially in that connected with the serous membrane. Sometimes it is pure; more frequently it is complicated; and the morbid structure with which it is most frequently associated, is the medullary. Microscopically, it is found to consist of cells, containing pigment or colouring matter, black, or of a dark brown colour; deposited in points; collected in masses; spread out in flat streaks or patches: or diffusely infiltrated. Accordingly, the morbid formation is termed *punctiform*, *tuberiform*, or *stratiform*. The Tuberiform is that which forms the true tumour, and comes to occupy the attention of the surgeon. The external surface is of a shining and mottled appearance; the form is more or less globular, and lobulated: the size is seldom great, rarely

indeed exceeding that of an egg, in the human subject ; inconvenience is slight, and scarcely amounts to pain. The dark colouring matter is itself non-vascular. The stroma, in which it is imbedded, is fully vascularized ; at first, it may consist of the original texture ; subsequently, and soon, it becomes a new structure, of evil tendency. The most frequent site is in the globe of the eye ; usually connected with medullary formation ; the melanotic matter seeming to be the primary change, the medullary of secondary occurrence ; and, perhaps, the frequency of this site may be connected with the normal pigment of the choroid coat. The Punctiform is found in the texture of internal organs, as the liver and lungs ; sometimes in sub-serous cellular tissue. The Stratifiform is almost peculiar to the latter situation ; though it is also occasionally found on the exterior of the membrane, as if a plastic exudation. A fourth kind, the *liquiform*, is found in the interior of cysts—either single, or part of a cysto-sarcoma ; and also in the interior of melanotic masses, which have begun to soften.

The Tuberiform melanosis, when situated externally, follows the ordinary course of the “tumor mali moris ;” involves the skin, ulcerates, and discharges black matter, with a fœtid sanious secretion. And by this time, usually, the medullary structure has also been developed ; giving to the sore more or less of a fungating character ; involving the system in the wonted cachexy ; and dragging the surrounding parts into rapid assimilation of structure. The melanosis, though doubtless in itself neither simple in structure nor benign in tendency, yet is to be chiefly regarded as malignant, on account of that tendency to associate with a more sinister formation, which it so strongly and almost invariably manifests. It seldom occurs but in those of advanced age ; therein differing markedly from the simple cephaloma. A constitutional vice, doubtless, accompanies ; but not so intense in itself, nor so obvious in its indications, as in the other malignant tumours ; unless with one or other of these the melanosis become associated.

There is no hope of cure, but from free extirpation by the knife ; and that at an early period, ere the medullary complication have begun to form. Return, under such favourable circumstances, is less likely, than in any other malignant disease. When the complication has occurred, with either the carcinomatous or the medullary formation, the minor is to be regarded as merged in the greater evil ; and the rules of treatment are to be enforced, as if the case were one of carcinoma, or of medullary tumour, alone.

IX. FUNGUS HÆMATODES.—This term has been, by many, held as synonymous with the medullary sarcoma ; and otherwise greatly misapplied. In order to constitute a true Fungus Hæmatodes, three things are essential ; that there shall be a fungous projection of morbid structure ; that the fungus be dark and blood-like ; and that it bleed, more or less profusely. This condition may be either of a primary or of a secondary character ; much more frequently it is the latter. Examples have occurred in which, without other morbid formation, a small, dark fungus has shown itself, bleeding profusely from time to time, perilling life, and demanding the most urgent measures for its removal. But, more frequently, there is first a tumour of malignant character, which

opens, and ultimately throws out the bleeding fungus. The fungus hæmatodes, in this, the most frequent case, is to be regarded as the climax of malignancy in a formation already of evil nature. The morbid structure, in which it most frequently supervenes, is the medullary. The untoward symptoms are all much aggravated by the accession; the cachexy becomes more marked; the frame sinks lower and more rapidly; the malignant hectic has an acute exacerbation; pain and misery are great; exhaustion is rapid; and fatal sinking is not long deferred.

In tumours, there may be two steps of degeneracy. From the simple structure to the medullary; from the latter, to the condition of fungus hæmatodes. But, usually, the medullary formation, from which the bleeding fungus springs, is of primary origin. All medullary tumours, when open, tend to fungate; but all medullary fungi are not entitled to the appellation of fungi hæmatodes. It is easy to understand, however, how the hæmatoid condition should not unfrequently occur; by softening and breaking down of the medullary texture, whereby one or more of the large vessels found permeating such growths are opened into. A detached portion of the medullary mass, or a fresh protrusion, may temporarily occlude the aperture; but, in its turn, it crumbles away, and the bleeding recurs. The part is obviously incapable of adopting the ordinary natural hæmostatics.

This is the most malignant of all morbid structures, and little amenable to treatment. There is no hope but from early removal by the knife; and, in most cases, amputation of the member is preferable to excision of the part. But, do what we will—however early, however summarily—too generally the disease returns, and the patient falls its victim. And when we consider that the greater number of cases are merely the advanced stage of medullary tumour, we can readily understand how the experienced and judicious surgeon, encountering an example of fungus hæmatodes, finds himself constrained to non-interference, and has to content himself with palliating what he cannot cure.

The *Erectile Tumour*, or aneurism by anastomosis, simple and analogous in structure, but dangerous in tendency, and troublesome in treatment, has been already considered.

Such are the solid tumours of the soft parts, simple and malignant. It may be here not inopportune to make some general observations on their removal by the knife.

Sometimes even the most experienced are in doubt as to the exact nature of a swelling; whether it is a solid tumour, tense, and very elastic; or a cystic formation, partly solid and partly fluid; or a mere accumulation of purulent or puriform matter. It were a great mistake to plan and commence extensive incisions, for what demanded only a trifling puncture. In order to guard against such an accident, the thrust of an exploratory trocar or needle is expedient; an ordinary trocar, of small size; or a rather large needle, grooved on one side, so as to permit of free lateral escape of fluid. But such exploration is by no means so light a matter as some would seem to consider it. It is not

warrantable to plunge a trocar into any and every tumour, of whose nature there may be any doubt. If it be an abscess, no harm ensues; the puncture is immediately enlarged, for the purpose of due evacuation. If it prove to be a solid growth, there may still be no harm, provided patient and surgeon are prepared, at once, or at all events within a day or two, to proceed to extirpation. But much injury will not fail to result, if, after the puncture, the tumour be left to itself for some considerable time; and, more especially, if absurd attempts be made, by stimulation, to effect removal by absorption. Then, there is no more sure exciting cause of a tumour's degeneration, than the thrust of an exploratory trocar. On a section having been made of the mass, after ultimate removal, the origin of the doubly depraved structure may not unfrequently be seen in the instrument's track. While, therefore, exploration is expedient, to guard against error of diagnosis which otherwise might occur, and which might lead to serious error in practice—its use ought to be limited to very doubtful cases, in which other means of diagnosis, patiently and skilfully used, have failed to satisfy; and not even in such cases should it be had recourse to, unless early operation, if not immediate, have been determined on, in the event of the swelling being proved to be an undoubted tumour.

As a general rule, the line of incision should be parallel to that of the subjacent muscular fibre; for then the wound will be more easy of coaptation, and consequently more capable of adhesion. But to this there are exceptions. When important blood-vessels or nerves are concerned, we cut in the line of their course, and so encounter less risk of injuring them. In the forehead and face, we often cut nearly transversely to the line of muscular fibre, finding it to be of more importance, as regards both subsequent deformity and immediate coaptation, to be in the line of the habitual integumental folds—the result of muscular action. Also, the external incisions should be always free; rather too extensive than otherwise; for thus both the facility and safety of dissection will be materially favoured. Besides, an excavation, with but a narrow integumental orifice, is much more likely to prove troublesome by suppuration, than a more extensive yet simple wound, whose largest dimension is superficial.

The integumental incisions are much facilitated by previous tension of the skin; but, when the lines or points are important guides to the relative anatomy of the subjacent parts, while they are stretched let them not be displaced.

The incisions should commence where the principal blood-vessels and nerves enter, and advance steadily from that point. The nerves are cut at once, and thus the subsequent dissection becomes comparatively painless. So are the arterial trunks; and, being compressed as soon as cut, the operation in consequence is also comparatively bloodless. Following an opposite course, an unnecessary amount of blood is lost, the number of ligatures is great, and a protraction of severe pain is unwarrantably inflicted. Also, unless the hemorrhage be very alarming, or the patient be already so sunk by disease as to be incapable of bearing loss of blood, deligation of the cut vessels should be reserved till after the tumour's removal; temporary arrest being entrusted to the

fingers of an assistant. Thus, time is saved in the most painful part of the procedure; and the number of ligatures will also be diminished, it being likely that some of the smaller branches—important enough to have demanded deligation at the time of their section—will be found satisfactorily closed by completion of the natural hæmostatics, assisted by the temporary pressure.

A tumour placed over the course of large nerves, blood-vessels, or other important organs, may seem to be completely separate from them; yet in many such cases the operator finds, during his dissection, that his previous examination has, to a certain extent, deceived him; the prolongations, even of a simple tumour, often extending to a much greater depth than was externally indicated. On the other hand, a large artery, or nerve, passing through a tumour, may seem to be irrevocably incorporated with its structure; yet, if the morbid structure be not malignant, the artery or nerve, so situated, is not to be rashly sacrificed in the operation; they may pass innocently through, without being implicated in the structural change; and a careful dissection may leave them intact, yet without any portion of the tumour adherent.

Let the dissection advance regularly, from one aspect of the tumour to the other, and not by alternate cuts or scratches at various points; the procedure will thus be more seemly, simple, and safe. In removing benign formations, firm and circumscribed, from the vicinity of important parts, as blood-vessels, nerves, cavities, and canals, let the knife's edge play closely on the tumour, each stroke telling on its surface; and by traction on the tumour, remove it at the same time as far as possible from the contiguous parts. Thus the latter are saved, while, at the same time, we can make sure that the whole of the diseased formation is taken away. But, if the tumour be either avowedly malignant, or suspected of evil tendency, the incisions must be conducted on a precisely opposite principle. If the adjacent parts be such as not to admit of free cutting around the tumour, refrain from operation altogether. And, in all practicable and expedient cases, cut away from the tumour rather than on it; for, as already stated, unless a border of apparently sound texture be taken away, along with the tumour, we can never be certain but that many germs of the disease are left behind, rendering reproduction inevitable.

The operator should never be in a hurry. If hemorrhage is troublesome, it can always be restrained either by pressure or by ligature. Hasty play of the knife, in the case of the simple tumour, may endanger important parts, which ought to have remained untouched. In the case of the malignant formation, there is not only the same danger, but a greater; there is the risk of leaving a portion of the morbid structure unremoved. In any operation, haste is inexpedient; here it is highly culpable. The knife should proceed leisurely; following eye and finger, if need be. And, to make certain of entire removal, the extirpated part should be carefully examined at its cut margin, to see that no suspicious texture has been cut through, instead of having been cut away. If an unsatisfactory portion be detected, the corresponding part of the wound should be carefully dissected out; and, not until this assurance has been made doubly sure, should coaptation be effected.

In operating in the axilla, or at the lower part of the neck, the larger veins should be interfered with as little as possible; tension of vascular parts, previous to incision, should be avoided; and the other means should be taken, which tend to obviate the accidental entrance of air into the veins. It is during the dissection of deeply-seated tumours, that such casualties are most liable to occur.

Some pendulous tumours of a narrow pedicle—as certain of the adipose sarcomata—enlarge greatly in their free portion, and cover a large extent of surface. It is well first to amputate this pedicle, on a level with the surrounding skin, in order thereby to facilitate extirpation of the remainder. Also pendulous tumours, sometimes, by their own weight, withdraw their deep attachments, which become more and more superficial. In such cases, an artificial traction may be made to assist the natural tendency, rendering the subsequent operation comparatively easy and safe.

Deep and massy walls of fat are inimical to adhesion of a wound. Therefore, in operating on subjects of obesity, it is advisable to remove a suitable portion of the subcutaneous fatty texture along with the tumour, by inclining the knife to the required extent.

In extirpating malignant tumours, especially the cancerous, we have to avoid both a too sparing and too free removal of the integument. If over-anxious to have an easily coaptated wound we have spare skin already involved, rendering reproduction certain; and, on the other hand, if much skin be sacrificed, reproduction will also be favoured by tightness and irritability of the cicatrix. When in doubt, it is surely well to err on the safer side, making every consideration secondary to thorough removal of the diseased parts.

When a large and deeply-seated tumour involves a difficult and dangerous dissection, this may be facilitated by removal of the principal part of the growth first exposed; and simple bisection of it may sometimes answer the same end. Also, when the knife has gone as deeply, or as near to important parts, as seems consistent with safety, the remainder of the tumour—if simple—may be treated by ligature; as in the removal of central bronchocele, whose increase is interfering seriously with respiration.

In the case of hopeless tumours, which preclude all attempts at extirpation, by their extent, vascularity, and important connexions—and which at the same time threaten death, while yet occult, by interference with important functions—life may be prolonged, and suffering alleviated, by division of external parts, so as to relieve tension and permit of freer outward growth. In large bronchocele, threatening asphyxia, for example, it may be expedient to divide the sterno-cleido-mastoid muscles, and perhaps also the cervical fascia, subintegumentally.

Finally, let us guard against either error:—of wasting valuable time, in attempting to discuss tumours not amenable to such treatment; and of excising all which come under our cognizance, if locally practicable, without regard to ulterior consequences. In the first instance, we deprive the patient of his best, and perhaps only, chance of safety. In

the second, nothing but evil ensues, to all concerned ; the surgeon, his patient, and his profession, all suffer ; the first two perhaps irremediably.

Encysted Tumours.

The secreting cyst, which is the primary and most important part of this class of tumours, may either be an original structure, or adventitious ; most frequently it is the former. The formation may occur in any part of the body ; in the internal organs, as the ovary ; in the substance of glandular structures, as the mamma ; then the cyst is of adventitious growth. The most frequent site is on the surface of the body, more especially on the head and face ; and then the cyst is merely an enlargement of an original texture. For there seems no reason to doubt the explanation of the origin of these *wens*, as they are often called, given by Sir Astley Cooper ; namely, that they result from obstruction of an ordinary sebaceous follicle, and consequent dilatation by accumulation of its contents. Were the swelling rapid, and attended by an inflammatory process, a pimple, or boil, would form. But the growth is very gradual, and wholly non-inflammatory. The sebaceous secretion accumulates and distends the follicle, the parietes of which are not merely expanded, but receive support by nutrition, and by condensation of the surrounding parts ; the obstructed orifice, for some considerable time, remains apparent as a black central point ; afterwards it wholly disappears, and the tumour is enveloped by smooth, tight, and thin integument, without breach or depression. The scalp, and eyelids, especially the upper, are by far the most frequent sites of such formations. In the former situation, they seldom occur singly, but in numbers ; and vary in size from a pea to an orange. In the latter, they are usually single, and seldom exceed the dimensions of a pea or bean. The cyst, if unirritated by pressure, friction, or other stimuli, is very loosely adherent to the surrounding parts ; delicate in the eyelids ; strong and thick in the scalp. After repeated or habitual excitement, it becomes intimately incorporated with the parts exterior, and can be separated from them only by regular dissection. The contents are various ; at first, steatomatous, being merely an accumulation of the ordinary secretion, somewhat perverted ; afterwards, and usually soon, changes occur. Sometimes the contents are of semi-fluid consistence, like honey, and are termed meliceritous ; sometimes like pap, atheromatous ; sometimes serous ; sometimes they have a fibrinous appearance, aplastic ; sometimes, in consequence of the cyst having assumed the inflammatory process, they are of a purulent character ; by persistence of inflammation, an open condition may be produced, and a state of foul ulcer presented ; and, under the circumstances last mentioned, degeneration into a medullary formation, or a cancerous ulcer, is not improbable, more especially if the patient be advanced in years, and if the inflammatory accidents have been of frequent occurrence. Sometimes, after the open condition has been attained, all vascular excitement of an inflammatory kind ceases ; and yet the part does

not heal over in the ordinary way, but, assuming an extraordinary cuticular function, commences a horny growth, which, if unopposed, may attain to large dimensions. Such horns, several inches in length, and bulky in proportion, have been cut from the forehead, and from various parts of the scalp. Sometimes calcareous matter, even in considerable abundance, is found in the substance of the cyst itself, and in its interior. The contents of the thin cysts, which occur in the eyelids, are usually colourless and glairy; not unfrequently they contain hairs, of much delicacy, like stunted eyelashes, abulbous, and more frequently unattached than adherent to the sac. The ovarian cysts are usually filled with contents more or less fluid; glairy and clear, or more or less puriform in their character. Sometimes they have been found to contain not only hair, but skin, teeth, and bones—as if the aborted development of another creature.

Treatment.—The superficial encysted tumours of the scalp and face are those with which the surgeon is most frequently called to deal. If recent and small, with the vestige of the obstructed orifice still visible, they may be got rid of by expression. With the point of a pin or probe, the aperture is re-established; and through this, long strings of the sebaceous matter may be expressed, by gradual pressure of the finger and thumb, until the cyst is emptied. The pressure may require repetition; the cyst contracts; the aperture remains pervious; and the normal condition is restored.

In the great majority of cases, however, there is no vestige of opening, the contents have ceased to be of the sebaceous character, and the method of treatment by expression is inapplicable. If the size be not great, and if the part have not been irritated by accident or design, the method by incision and evulsion is to be preferred; a method applicable to the great majority of encysted tumours of the scalp. The tumour is transfixed, and bisected, by a scalpel or bistoury. The contents are extruded, so as to disclose the cyst; and this, having been firmly laid hold of by well-pointed dissecting forceps, at its cut edge, is lifted out of its place, unbroken. If any adhesion prove stronger than was expected, it is to be touched by the edge of the knife, rather than that violence should be used in the evulsion. It is seldom that any vessels demand ligature. After the oozing has ceased, the integuments are carefully replaced and adjusted, and the treatment is conducted so as to favour adhesion.

If the tumour be large, redundancy of integument would result from the employment of this method; favouring suppuration, profuse and tedious. In such cases, therefore, excision is expedient. By two elliptical incisions, a sufficient amount of skin is taken away, as in the removal of a solid formation; and then dissection is proceeded with regularly, great care being taken that the knife do not puncture the cyst; otherwise, by escape of the contents, the tumour would collapse, and completion of the operation be much impeded. Also, we should ~~not~~ be equally certain of having removed the whole cyst; a point which is indispensable in all cases; for, if the slightest part of the secreting surface remain, we may be well afraid either of reproduction, or at least of troublesome consequences.

To the slender cysts of the eyelids, neither the method of excision nor that of evulsion is applicable; the cyst is too delicate to admit of either. Incision, with cauterization, is to be practised. The cyst having been opened, the glairy contents are discharged; and a pencilled point of nitrate of silver is then applied to every part of the secreting surface. This is wholly destroyed, and comes away in the form of a small slough; the space soon fills up and cicatrizes. For a structure of such delicacy, the nitrate of silver is found to be quite a sufficiently powerful caustic. To use a stronger, would be to inflict unnecessary pain; and also, by destroying an unnecessary amount of texture, to endanger the occurrence of some deformity by cicatrization. Sometimes incision, followed only by thorough clearing of the interior by means of a probe, proves effectual; but, as a general rule, it is better to make the desired destruction certain, by a light use of the light escharotic.

An encysted tumour, inflamed and suppurating, is treated as an ordinary abscess; by free incision. No escharotic is necessary. The cyst is sufficiently disintegrated by the ulcerative action, which follows on the open condition. Healing, though probably tedious, takes place in the ordinary way.

When degeneration has begun in an encysted tumour, the part must be surrounded by free incision, and carefully dissected out, at as early a period as possible, according to the principles formerly inculcated.

Inflammation of an encysted tumour is never desirable: for the process is apt to prove excessive, unmanageable, and altogether untoward. In certain situations, it is by all means to be avoided. On this account, mere puncture of an encysted tumour of the scalp, however small and simple, is never expedient; inflammation and suppuration are sure to follow; erysipelas, in a dangerous locality, is not unlikely still further to complicate the case; and lastly comes the risk of degeneration.

Removal of an encysted tumour, whose contents are serous, is quite possibly by absorption. The event, however, is so rare as not to warrant the expectation of this in practice.

Encysted tumours, formed in the interior of a part, are best treated by regular dissection, as if they were of solid structure. The ovarian cysts require a separate consideration, which will be afterwards afforded.

TUMOURS OF PARTICULAR TEXTURES.

Tumours of the Integument.

Warts are of two great classes, simple and malignant. The simple are considered to be prolongations of the papillæ, changed somewhat into structure as well as hypertrophied; sometimes flat and diffused; sometimes prominent, and cylindrical in form. When situated on the outer part of the body, the investing cuticle is thick, rough, and dry. On the inner, and more especially when opposing surfaces are affected, as in the thighs and nates, the cuticle is thin and delicate, and a serous discharge is exhaled. These formations may again be divided into

common and specific ; the former of spontaneous origin, unconnected with any apparent cause ; usually dry ; and non-contagious. The latter dependent on venereal or other poison ; humid ; and contagious. Sometimes these attain to an enormous size.

The vitality of such structures is weak ; and occasional touching with a minor caustic—such as nitrate of silver, aromatic vinegar, &c.—suffices for the decadence. If the form of the wart be suitable, the destructive process may be accelerated by either ligature or scissors.

Warty formations on the skin are not unfrequently of a malignant kind, in the aged ; and are most commonly situated on the face. The wart is of an angry and irritable character, and soon degenerates into the cancerous ulcer, surrounded by more or less of the carcinomatous deposit. The remedy is, free removal by excision, if possible before open degeneracy has been fully established. All warts of the face, indeed, should be removed, at whatever age, and however simple their nature may seem to be ; they all being most prone, if not certain, to degenerate in advancing years.

The skin is liable to a simple *Hypertrophy*, extending over a considerable surface. The texture becomes rough and open ; the rugæ and markings are large and broad ; and the apparatus of the capillary, sebaceous, and sudorous secretions become wonderfully apparent. Pressure, and the use of iodine, will suffice at least to arrest increase of growth ; and considerable decrease may even be effected. Should the bulk be great, and prove troublesome, the changed texture may be removed by incision, either wholly or in part ; being a simple hypertrophy, and not a true tumour, partial removal does not entail reproduction.

Hypertrophy of the skin, however, is more frequently associated with a similar condition of the subcutaneous adipose and cellular tissues ; constituting a species of *Lipoma*. To this the integuments of the face, especially of the nose and cheeks, are subject. At the same time, there is much discolouration of the integument by passive congestion, which is constant. The cure is, removal by careful dissection ; the general health being at the same time attended to. Usually there is a great demand for alteratives, and regulation of diet.

The nævus and erectile tumour, carcinoma and cancer, are often met with in the integument ; amenable to the ordinary rules of treatment. And the encysted tumours, as we have just seen, are usually situated on the surface.

Tumours of Mucous Membrane.

To such tumours the term *polypus* is applied. They are of various kinds. 1. The simple mucous. 2. The cysto-mucous. 3. The fibrous. 4. The medullary. Sometimes, but rarely, the structure is carcinomatous. The first two are simple in structure, and benign in tendency. The third is of doubtful character, and prone to degenerate. The last are most malignant.

1. *The Simple, Benign, Mucous Polypus*, differs but little, in appearance, from the original texture in which it is produced ; in structure, it is softer and more pulpy ; less vascular, only a few sluggish vessels

being seen coursing on its exterior; of paler hue, and much less sensibility. In fact, it seems to consist of plastic exudation, but sparingly organized, and having made little progress by transition or assimilation of structure. The mass is pyriform, attached by a narrow peduncle. They seldom occur singly, but in clusters; the majority, however, are for a time held in the background by one or two large tumours, which fully occupy the space in which they grow. The attachment does not extend to a greater depth than that of the mucous membrane. They are most frequently found in the nasal passages; sometimes, but much more rarely attached to the mucous membrane of the genito-urinary system; and the respiratory and alimentary canals are not altogether exempt.

The treatment is by evulsion. The tumour is laid firm hold of by forceps, at its narrow neck, as close as possible to the point of attachment; and, by a twisting movement, combined with that of gentle pulling, the attachment is torn away, and the part removed. There is no reproduction; but it may be simulated. For, some of the small polypi, formerly compressed, now expand and grow apace; the disease is reproduced, doubtless, though not by return of the original tumour; and of this circumstance it is necessary to apprise the patient, to prevent disappointment. But little hemorrhage follows; and it is easily restrained by pressure. No violence is necessary, in the evulsive effort; it is besides inexpedient, tending to tear away an unnecessary extent of membrane, perhaps with a portion of subjacent bone, and also to augment the hemorrhage. If the polypus be large, and situated unfavourably for the use of forceps, its neck may be included in ligature, so as to cause sphacelation of the mass.

2. *The Cysto-mucous Polypus* may be original; or the preceding form, by long endurance, may change into this. The structure is not homogeneous; but contains cavities, filled with clear, glairy fluid. The colour is paler; at the fundus, often of a pearly white hue. The texture is more dense; especially at the parietes of the cysts, which are sometimes almost cartilaginous. The form, attachment, tendency, and treatment, are the same. This variety seldom occurs but in the nostrils.

3. *The Fibrous Polypus*.—This is of the same structure as the fibrous tumour; invested by mucous membrane; of a cylindrical shape; and attached by a broad base—a little less extensive than the apex of the tumour—not only to the mucous membrane and subjacent tissue, but, in the case of the nostrils, also to the periosteum; indeed, it may be said to be connected with the bone itself. Like the preceding varieties, it is the seat of little or no pain, and proves inconvenient chiefly by its bulk and position; but, while the others seldom if ever degenerate into the medullary or other malignant formation, this is prone to do so. Early removal is therefore expedient. If the neck be unusually narrow, the shape being more pyriform than is its wont, deligation may be employed. But, in the majority of cases, excision is demanded; it being most expedient that no remnant of the morbid structure should be left, lest reproduction ensue. And in order to effect this thorough removal, preliminary incisions, perhaps severe, are requisite in certain situations,

as will afterwards be shown. The fibrous polypus most frequently occurs in the nostrils, and in the uterus and vagina; sometimes in the pharynx.

4. *The Medullary Polypus*, may be a degeneration of the fibrous, or of original formation; most frequently it is the latter. Occasionally it is associated with carcinoma. It follows the usual course; and, when original, no hope of cure need be entertained. Its most frequent sites are the nares, antrum, pharynx, and œsophagus. In some few cases, when the formation is yet recent and apparently limited, and when it has been of secondary origin, free removal of all suspected as well implicated parts may be warrantable. But, in the great majority of cases, palliation only is within our reach; and we should attempt no more.

Similar observations apply to the nature, progress, and treatment of the carcinomatous growth, which is more rare in connexion with mucous membrane.

Tumours of Nerve.

All tumours are liable to occur in connexion with the nervous tissue; but two are peculiar to it, the *neuroma*, and *painful tubercle*.

Neuroma.—This is a simple tumour of the fibrous character; consisting of dense plastic matter lodged amongst the fibrils of the nervous tissue, which are thereby separated, and usually rendered the seat of perverted sensation; the nervous fibres at the same time undergoing hypertrophy of structure at the affected part. Sometimes, the formation occurs spontaneously; more frequently, it follows remotely on wound, or other external injury. It may take place in the course of an undivided nerve; more frequently, it forms on the truncated extremity, after division. When in the former situation, it usually arises without any appreciable cause; is of an oval shape, and may attain to the size of a prune or small egg; above and below the enlarged part, the nerve resumes its wonted form and appearance. After wound, as on the face of a stump, the neuromata vary in size, according to the original dimensions of the nerve affected. The nerve, for some way above, is also slightly increased in size, tortuous, and unusually vascular. Under all circumstances of healed wound, the cut portions of nerve undergo an enlargement and condensation; a process analogous, in one sense—yet the opposite, in another—to the obliteration of the arterial trunks similarly situated. And it is probable, that the neuromata are caused by a similar action and change of structure, which have transgressed the limits of expediency. The ordinary bulbous end of cut nerve, in a stump or other wound, is not painful or inconvenient; but the neuroma—an exaggeration of this—is both, to a very great degree. Besides, the neuromata, in the stump, are in general intimately incorporated with the hard cicatrix, which is tightly adherent to the bone and its dense investing textures; and this circumstance, of itself, might be the cause of much irritation to the nerves which it implicates, even if these were otherwise but little altered in structure.

The pain of the neuromata is great, though not constant; increased by pressure; often presenting all the characters of intense neuralgia;

embittering existence, and greatly deranging health. Epilepsy has been known to follow, apparently, from this cause; hysteria, not unfrequently.

The remedy is by extirpation. In the case of neuroma formed on undivided nerve, the swelling is cut down upon and exposed; and the nerve having been cut across by a finely edged knife, at a little distance above and below the enlargement, the diseased part is dissected away from its surrounding attachment, to which, usually, it but loosely adheres. This entails paralysis of that nerve for a time; but the structure is reproduced, and function restored more or less completely; and, even were it otherwise, surely the absence of all sensation were preferable to pain of an excruciating intensity. In the case of a stump, or other wound, if there be one or two distinct and circumscribed tumours, they may be removed in a similar way. But usually they are numerous, and intimately incorporated with the dense ligamentous structure forming the cicatrix. And, under these circumstances, a second amputation is necessary; taking away all the neuromata, as well as the changed structure in which they are almost inextricably impacted. In doing so, the nervous section should not only be effected with a finely edged instrument, but made higher than that of the other textures, in order to make sure that the cut extremities shall not again become entangled in the cicatrix. Sometimes, however, notwithstanding all care in such particulars, the neuromata, or at least the neuralgic pains, return; a circumstance apparently attributable rather to a constitutional than to a local cause, and demanding general treatment accordingly.

Painful Tubercle.—This is often termed also Subcutaneous, its most frequent site being the cellular tissue, immediately beneath the skin; and sometimes the integument also seems to be partially involved. Occasionally, however, it is found in the inter-muscular cellular tissue. The size seldom exceeds that of a pea or bean; and is often less than either. The structure is distinctly fibrous; and appears very similar to that of the neuroma; but more dense; and sometimes containing points, if not actually bloody, at least of a blood-like appearance. This last appearance, however, may be accidental, the result of external injury; and probably is so; for, the structure, in all other respects, seems to be simple and benign. Another difference from the neuroma is, that whereas in the latter, the nervous fibres are very apparent—here the fibrous matter seems to be mainly, if not wholly, a new production; no nervous trunk is continuous with the mass, only the minute terminal branches are capable of being traced into it. The tumour is very moveable, gliding under the finger; but it is intolerant of the slightest pressure, intense pain being produced thereby. The pain sometimes assumes the form of paroxysms, induced by the slightest external influence, and sometimes of spontaneous origin. More frequently than the neuroma, it has been associated with hysteria; but, usually, the general health is less disordered than in neuroma. It may occur in any part of the general surface; but is most frequent in the lower extremities.

The treatment is by excision. If the skin be at all involved, it is to be taken away along with the tumour, to the requisite extent, by means of two elliptical incisions; if the integument be free, a simple wound

suffices. There is no reproduction. Some general means may be subsequently expedient, to calm the nervous system, from excitement which the existence of the tumour may have induced.

Tumours of Bone.

These, like the tumours of the soft parts, are simple and malignant, analogous and heterologous. The great majority, if not all, are included in the following classification. *Exostosis*, *Osteoma*, *Enchondroma*, simple; *Osteosarcoma*, at first simple, but tending to degeneration and malignancy; *Osteocephaloma*, *Osteocarcinoma*, malignant; *Osteoaneurism*, troublesome and tending to disaster, sometimes associated with malignant structure; *Spana Ventosa*, analogous to the encysted tumours of the soft parts.

I. *Exostosis*.—By this is understood a growth from bone, of osseous structure, analogous to that from which it has sprung; following the same course of formation as in original ossification; a plasma is effused and becomes organized, then passes into transitional cartilage, and thence the osseous structure is gradually completed. At one time, the term was made to include all growths, fleshy, osseous, and cartilaginous; but, with propriety, it is limited to growth of bone from bone. There are varieties.

1. *The Dense or Ivory Exostosis*.—This is most frequently found in the flat bones, especially the calvarium. It consists of dense laminae, firmly compacted; incorporated with the dense external portion of the parent bone, to which it is quite analogous; usually of smooth and polished surface; its outline forming the segment of a comparatively large circle; and the size seldom exceeding that of a large nut, bisected. Growth is very gradual and slow, and altogether painless; when superficial, as on the skull, external form is interfered with, and that constitutes the chief inconvenience. Sometimes, its origin may be remotely connected with external injury; more frequently, there is no assignable cause. No treatment is required. Were the formation to take place on the internal aspect of the calvarium, serious disorder of the cerebral functions would probably ensue; and removal by the trephine would be expedient, were accuracy of diagnosis attainable. But, fortunately, such an event seldom if ever occurs. Bone, it is true, sometimes projects from the interior of the skull, and entails the most serious consequences; but it is of the spiculated, not of the flat and dense character.

2. *The Cancellated Exostosis*.—A minor and adventitious bone, of irregular form, projecting from one which is primitive; structurally similar, in all respects, to its parent; having both an external laminated portion, and internal cancelli; the latter either continuous with the cancelli of the larger bone, or shut off by its external laminated portion. In other words, sometimes the exostosis seems to be deposited on the parent bone, like the first variety; more frequently, it seems to grow out of it. This kind of exostosis seldom occurs but in the long bones of the extremities; and is most frequent in the femur. The cancellated texture usually predominates; the external dense portion being thin

and delicate. There is an investing continuation of the periosteum. Sometimes the attachment is by a narrow neck; but generally the form partakes more of the cylindrical than of the pyriform. In some cases, the size is small, and occasions little or no inconvenience; in others, the exostosis projects several inches among the muscles of the limb, greatly impeding their function. The growth is more rapid than that of the ivory exostosis; but still slower, and more insensible, than enlargement of an inflammatory kind. The growth of no form of exostosis is associated with the inflammatory process. Their origin, like that of other tumours, may be remotely connected therewith; but their formation is by a more simple perversion of the nutritive action. Some of these exostoses may be traced to a blow, or other external injury; pain and swelling ensue, of an inflammatory character; the inflammatory process and its pain subside, but the swelling remains; resolution is incomplete; and, subsequently, the enlargement is continued, of a circumscribed and prominent character. Not unfrequently, the exostosis is found at the site of a muscular insertion, where a process of bone naturally exists; and, by the play of that muscle, it may be supposed that an exaggeration of the normal process into an anormal exostosis is produced. In some cases, an ossific diathesis may be said to exist; even a slight blow being followed by an exostotic formation; such cases, however, are extremely rare. The skeleton, so susceptible, is prone rather to the inflammatory process, and its results—abscess, ulcer, caries, and necrosis—than to the simply nutritive action.

In the majority of cases, this variety of exostosis ought also to be left undisturbed. Interference is only warrantable, when bulk and position are such as to interfere with important functions—as of muscles, vessels, cavities, canals, or internal organs. Then, an incision may be made, the neck of the growth severed by a saw or bone-forceps, and the exostosis carefully dissected away. Cases demanding such treatment, however, are very rare. A small exostosis, protruding from the dorsal aspect of the distal phalanx of the great toe, is not uncommon; and is productive of so much lameness, and other inconvenience, as to invariably require removal. Sometimes, by external injury, an exostosis sustains fracture; inflammatory action is lighted up; the fractured portion dies; and acute suppuration takes place around. Under such circumstances, incision is required; free enough to permit not only evacuation of the abscess; but also removal of the necrosed portion. Repeated injury may fail to produce fracture, but may cause degeneration, even of this simple formation, into a soft and malignant structure; demanding ablation of a more extensive and formidable kind.

II. OSTEOMA.—Exostosis is a growth of bone from bone. Osteoma is an enlargement of the bone itself; hypertrophy, accompanied with great condensation of structure; and unassociated with the inflammatory process—therein differing from node. The enlargement is very gradual, and unattended by pain. External injury may be the apparent cause; or no cause may be assignable. All bones are liable to the occurrence; in any part of the skeleton it is comparatively rare; but the long bones of the extremities, and the lower jaw, may be reckoned its usual sites. The size is seldom very great. A section discloses great density of

structure, excepting perhaps a little portion of cancellous texture in the centre.

This affection of bone is originally most simple, and may long remain so. Yet it is liable to degenerate, either in consequence of repeated injury, or on account of an evil disposition having crept into the general frame during the advance of years. I have seen a section of such a tumour, dense and osseous throughout, except just at the centre; where an open space, not larger than to enclose a small nut, instead of being occupied by cancellous texture—as it, no doubt, originally was—contained a distinctly medullary substance. Early treatment, with the view of removal, is therefore highly expedient. In the first place, arrest of growth and discussion are to be attempted, by the ordinary means; for, this tumour of bone is analogous to the simple sarcoma of the soft parts, and amenable to absorption. Failing discussion, extirpation is to be had recourse to, by the knife and saw. When the site is unsuitable for extirpation, amputation is expedient; for, though the tumour be simple and safe for a time, no one can tell when it may begin to degenerate, demanding the operation under much more inauspicious circumstances.

III. ENCHONDROMA.—This is a cartilaginous growth, connected with bone; peculiar to early years; and usually attributable to external injury. The form is spheroidal; the size sometimes equals, but seldom exceeds, that of an orange. The growth is slow and painless; its nature is strictly benign; and there is little or no tendency to degeneration, even when, after many years' duration, ulceration of the investing integument may have occurred. The surrounding textures are not involved, but pushed aside. All parts of the skeleton are liable to the formation; but it is most frequently found in the metacarpal bones and phalanges of the fingers. The articulating cartilages are not involved, but form the limits of the growth in that direction; and adjacent tumours have no tendency to coalesce, but rather remain distinct. Occasionally, several tumours are simultaneously developed; the result not of a constitutionally malignant cause, but rather of "the widely spread influence of the exciting cause, which, in most instances, is a contusion."* The structure consists of two parts; a fibro-membranous interlacement, forming cells of different sizes, some equal to that of a pea, within which is contained the cartilaginous matter; softer than true cartilage, "more nearly resembling in consistence the soft hyaloid cartilage of cartilaginous fishes." The general appearance of the section's structure is strikingly conglomerate; and, by this form of structure, slight inequalities are usually imparted to the surface of the tumour.

There are two varieties. 1. The adventitious growth is developed in the interior of the bone. The formation gradually takes place in the cancellous texture; and the external portion, or shell, of the bone proportionally dilates. This outer shell, though attenuated by the distention, yet receives addition of new osseous matter from time to time, and long retains its continuity; ultimately, it becomes very thin, and in some places membranous; still the tumour retains its smoothness and

* Müller.

spheroidal shape. This variety, then, is invested by both bone and periosteum; it is that which most frequently occurs.

2. The second variety is formed on the exterior of the bone, and is covered only by the periosteum and other soft parts. It is generally met with in the flat bones; cranium, pelvis, and ribs. The interior of the tumour is the same as that of the preceding; the form is less regularly spheroidal, and the surface is more unequal.

Treatment.—Although enchondroma be little disposed to degenerate, still it is in no way amenable to absorption; and therefore demands removal by the knife. The first variety, external to the bone, is simply dissected away, the bone remaining entire. The second requires ablation of that portion of bone from which it is produced. If removal have been complete, reproduction need not be anticipated.

IV. OSTEOSARCOMA.—By this is understood a tumour, composed partly of bone, partly of fleshy substance—as the name implies; the latter constituent, of a simple and non-malignant kind. The formation is usually attributable to external injury, perhaps slight; and originates in the cancellous texture of the bone. The osseous part is analogous to the fibrous interlacement in tumours of the soft parts; dense and solid centrally; radiating in spicula outwards, which diverge, and interlace, leaving interstices, more or less wide, in which the fleshy substance is lodged. The interstitial structure is of different kinds. In some cases, it is chiefly cartilaginous; in others, of a fibrous character, or resembling the simple sarcoma; in others it is cystic. Most frequently, it is chiefly composed of sarcomatous substance, containing occasional points of cartilage. Cells, too, are usually found; being probably certain of the interstices, dilated, and unoccupied by solid matter; filled with fluid, sometimes glairy and clear, sometimes serous and turbid; they are seldom of large size, but may be numerous. Being lined by a secreting membrane, these cysts constitute the most dangerous part of the tumour; on perversion of their action, degeneration would seem to depend. In proportion as this growth in the interior of the bone is developed, the exterior shell becomes expanded; and, as in enchondroma, the latter for a time retains its continuity, in some places even with an increased thickness, by new osseous deposit; but, ultimately, at certain points—and these are usually towards the external surface—it becomes first thin, and pliable as parchment, and then entirely membranous. Even the membrane, after a time, gives way; and the superimposed soft parts, too, may tighten, inflame, and ulcerate, thus exposing the true structure of the morbid growth. But no sprouting fungus results, no hemorrhage, no fetid ichorous discharge; the discharge is purulent and moderate; the sore is simple; and cicatrization may be effected. The growth is more rapid than that of osteoma, but infinitely more slow than that of osteocephaloma; many months may have elapsed, and the tumour may still be no larger than an orange. Pain can hardly be said to attend; yet there is more inconvenience and discomfort felt, in and around the part, than in the simpler and more tardy formations of exostosis and osteoma. Pressure does not increase pain, materially, if at all; when made firmly, a crackling sensation is often experienced, partly from displacement of the parchment-like portions of the osseous

shell, partly from interference with the radiating osseous skeleton of the mass. The sensation of firmness imparted to the touch, is less than that of exostosis or osteoma; much greater than that of osteocephaloma. There is no elasticity, and the presence of fluid accumulation is not simulated. There is little or no constitutional disorder; unless important function be interrupted, by the bulk and position of the tumour. Often the patient seems to be, in all other respects, of even robust health.

This tumour seldom appears before the adult age. It is originally simple, and may long remain so; but it is prone to degenerate from slight causes, local or constitutional. Rapid growth, great pain, open condition, fungous protrusion, involvement of surrounding parts, and marked constitutional cachexy, often supervene after the infliction of but a trifling injury. Early removal, by operation, is in the highest degree expedient; while yet the tumour is small, and the wound may be slight and safe; while yet the structure and tendency are simple, and immunity from return may be secured.

When a long bone is affected by osteosarcoma, in its shaft, as but seldom happens, fracture at that point is not unlikely. After such a casualty, amputation is imperative; for there is no chance of re-union; while rapid enlargement, and avowed malignancy of the tumour, are certain and inevitable.

V. OSTEOCEPHALOMA.—This denotes the medullary formation as it occurs in bone; a most malignant and intractable tumour; and, unfortunately, not of rare occurrence. When osteosarcoma degenerates, it is to assume the characters of this. Then, instead of the fleshy interstitial substance, of a simple kind, there is the medullary deposit; commencing usually at a central part. The osseous skeleton for a time remains; but sooner or later it disappears, and its place is occupied by the soft brain-like mass. The exterior osseous shell, in like manner, is involved and changed; ulceration follows; the medullary substance, then exposed and unconfined, quickly establishes the condition of fungus; and an untoward progress is made, similar to what has been already described in the soft tissues. More frequently, the tumour is primary; medullary from the first; making no change, except from the occult to the open state, and perhaps to assume the condition of a fungus hæmatodes; rapid, painful, involving all textures, pushing none aside, and attended by a most marked and wasting cachexy. Sometimes, the brain-like mass originates in the soft textures exterior to the bone, and involves the latter secondarily.

The treatment is, by early and thorough removal; amputation of the limb is usually preferable to extirpation of the part; and it is a safe general rule, that, when practicable, the bone, in which the tumour has been produced, should not be sawn through at any part, but disarticulated. If an opportunity for early interference be not afforded, the knife should be withheld, and palliatives alone employed.

Diagnosis.—Practically, it is of the utmost importance, that we should be able to distinguish between osteosarcoma and osteocephaloma. Each is not of unfrequent occurrence; and each requires distinct rules of treatment. The most common sites of each, are the maxillary bones,

lower and upper; and next, the long bones of the extremities, especially near their articulating surfaces. But the flat bones, as the scapula, cranium, and pelvis, are by no means exempt. The prominent points of difference are the following; sufficiently distinct, to guard from error the experienced and careful. In the degenerating tumours, however, it is often not easy to determine, whether the simple or malignant structure yet predominates. 1. The osteosarcoma is seldom found prior to the adult age; the osteocephaloma may occur at any period, and is as frequent in the adolescent as in the adult. 2. The osteosarcoma is usually attributable, in its origin, to external injury. The osteocephaloma is more frequently of spontaneous origin. 3. The osteosarcoma is slow and gradual, and more or less uniform, in its growth. The osteocephaloma is much more rapid, and tends to enlarge unequally; growing chiefly at those points where there is the least mechanical resistance. 4. The osteosarcoma usually is almost, and sometimes altogether painless; unless when some nervous trunk or plexus is compressed. Osteocephaloma, from the first, is attended with severe lancinating pain. 5. Osteosarcoma is firm, and yields but little to the touch; even rude pressure is scarcely painful; an obscure crepitus is often felt. Osteocephaloma is soft and elastic, from an early period, the shell of bone and all other remains of the original texture soon becoming merged in the medullary formation; it is elastic, and affords no crepitus—when an original tumour; the pain is aggravated by even slight compression. 6. Osteosarcoma entails but little disorder of the general health. Osteocephaloma is attended with much cachexy, even from the beginning. 7. A casual abrasion of the skin, or mucous membrane, investing an osteosarcoma, shows a simple character; and may be brought to heal, under the ordinary treatment. A similar breach, in the surface of the osteocephaloma, does not heal, widens more and more, and becomes the site of a fungous protrusion. 8. The osteosarcoma does not invade the neighbouring tissues, but pushes them aside by its expansion, and abides within the bone in which it was first developed. In the upper jaw, for example, it remains limited to the expanded confines of the antrum. And, at those parts where the bony and even membranous parietes are deficient, there is no ulceration followed by fungous protrusion; but only a moderate increase of growth, in a lobulated form, with or without a rawness of the surface. The osteocephaloma, on the other hand, pushes no texture much aside, but early involves all; the antrum is soon passed beyond; and the base of the cranium is affected, even before much appearance has been made externally. Wherever deficiency of the investing texture occurs, ulceration and fungous growth are sure to follow. 9. The osteosarcoma long continues in the occult condition; breach of the surface, when it does occur, does not extend rapidly, and evinces no malignancy of character; the discharge is purulent, or puriform, not profuse; there is no tendency to hemorrhage, unless by accidental injury, and then it is slight and easily restrained by pressure. The osteocephaloma soon passes from the occult to the open state. The ulcer spreads, and is obviously the seat of malignant structure and action; the discharge is profuse, fetid, and bloody; hemorrhage

is not unlikely, of spontaneous origin, and little amenable to control. 10. Osteosarcoma does not spread, either by contiguity in the tissues, or remotely by the lymphatics. Osteocephaloma does both; at an early period, the lymphatics are manifestly and hopelessly involved.

Such are the striking differences between the two tumours. The distinction is equally great in the treatment applicable to each. If the tumour be an osteocephaloma, operation is warrantable only at a very early period; when there is a certainty that the whole of the affected parts, and something more, can be wholly removed; and when there is good reason to hope, that the constitution is not much and irreparably involved. An osteosarcoma, on the other hand, admits of operation till a late period; its extirpation may be fearlessly attempted, with a good hope of success, even after the tumour has attained to an enormous bulk; and experience has fully shown, that though the operation may be bloody and severe, yet it seldom terminates but in a fortunate issue. In regard to prognosis also, the tumours widely differ. After removal of an osteocephaloma, even under favourable circumstances, we can never be certain of immunity from return. When a genuine osteosarcoma, on the contrary, has been taken away, the mind may be at ease; for return is very improbable, even when the operation has been performed at an advanced age of both tumour and patient.

VI. OSTEOCARCINOMA is comparatively rare. When it does occur, it is usually as a secondary symptom of a malignant cachexy, the primary indication of which has been the formation of a carcinoma in the soft parts—as in the mamma. The formation of the secondary growth, as formerly observed, is often excited by the occurrence of fracture. Under such circumstances, all hope of cure is vain.

Osteocancer, a malignant ulcer of bone, is not uncommon; usually of secondary origin also; the invasion having come from the soft parts. A malignant ulcer of the scalp, for example, not unfrequently involves the subjacent skull in a hopeless loss of substance. A similar occurrence, in either of the extremities, would warrant amputation, unless lymphatic tumour, or other indication of an irrevocably involved system, should contra-indicate all active interference.

VII. OSTEOANEURISM.—The bones may be variously affected by a morbid condition of the blood and blood-vessels. 1. A kind of false aneurism may form, in the cancellous texture; an artery giving way, and blood accumulating so as to distend the cortical portion into the form of a tumour, of greater or less magnitude. This may be the result of external injury, by rupture of the arterial coats; or may form spontaneously, by arterial ulceration. The cure is to be attempted, by deligation of the principal arterial trunk leading to the part, and by uniform, sustained compression of the tumour. Should this fail, or be deemed either impracticable or unadvisable, removal of the affected bone, or portion of bone, by the amputating knife, will be expedient; if the part be so situated as to admit of this operation. For were the disease left to itself, the open condition would, sooner or later, be attained, and death by hemorrhage ensue. A remarkable example of this disease occurred to Mr. Liston, and is related in his *Elements of Surgery*, p. 170.

2. An erectile tumour may become developed in the cancellous texture, expanding the cortical portion of the bone, so as to form, as it were, its outer case. The symptoms are necessarily obscure. Fortunately, the occurrence is rare. Deligation is plainly inapplicable. Amputation must be had recourse to.

3. Either of the preceding varieties may be conjoined with medullary deposit. Early and free removal, by the knife, is plainly and urgently indicated; but with an unfavourable prognosis, as to the probability of return.

VIII. SPINA VENTOSA has been already considered, and the points of difference shown between it and chronic abscess. For the sake of uniformity in nomenclature, it might be termed *osteocystoma*; being, as formerly stated, analogous to the encysted tumours of the soft parts. The contents are not purulent, but serous, or of a glairy or gelatinous character. The cyst is not a pyogenic membrane, but a structure analogous to that of the encysted tumour. The growth is slow; the bulk acquired may be enormous.

For the smaller of such tumours—small not only in themselves, but also in relation to the bone from which they spring—evacuation by opening and counter-opening, and compression, with a view to contraction and consolidation, will suffice. In the larger, it is better at once to have recourse to amputation of the affected part.

SECTION IV.

OF INJURIES.

CHAPTER XVI.

OF WOUNDS.

THE term wound need not be defined. It is used in surgery in its ordinary acceptation. Many such injuries are the result of accident; others, of design. They vary in extent and importance, from a mere scratch to amputation of the hip-joint. But, indeed, all are important; and should never be regarded either as trivial, or as matters connected with a part alone. Those apparently most simple may involve, ultimately, much suffering and danger. Hemorrhage, erysipelas, gangrene, hectic, tetanus, may follow any wound; bringing life and limb into the most imminent peril.

Wounds are of different kinds; and, classifying them, we speak of Incised, Contused, Lacerated, Punctured, Poisoned, and Gunshot wounds.

I. INCISED WOUNDS.—These are inflicted by a sharp-edged, cutting instrument. They are the most simple and favourable kind of injury; being the most capable of speedy union by adhesion, and least liable to inflammation or other accidents. Their surface is greater than their depth; and they are free from laceration and contusion. Their most prominent symptom, and greatest danger, is hemorrhage; especially the arterial; a subject which has already engaged our attention.

In the treatment, our first care, as formerly stated, is to arrest the hemorrhage. Our second is to remove foreign matter, which may be present. The third is to arrange and superintend the wound, so as to favour the mode of union which, under the particular circumstances of the case, we desire.

Wounds heal in various ways. 1. *By adhesion*, or “union by the first intention;” a process, as formerly stated, independent of true inflammation, and altogether incompatible with it. For its occurrence, three things are essential. That the surfaces of the wound shall be in close and uniform contact, and be retained so; that a sufficiency of normal circulation shall be maintained in the part; and that true inflammation shall not become established. To obtain the first, surgical

manipulation and adjustment are necessary ; for the second, the existence of ordinary life in the part is sufficient ; the third is the object of our especial care, in the management of both the part and the system. Liquor sanguinis is effused in moderate quantity ; its serum separates, and trickles from the wound ; the fibrin remains, in the form of a thin layer investing the cut surface. It coagulates, becomes organized and vascularized, in the manner formerly mentioned ; and, constituting a new living structure—of cellular tissue and capillaries—incorporated with the cut surfaces, restores the solution of continuity in the solid parts. After a time, the originally simple form of structure is exalted ; and simulation is effected, with some exceptions, of the normal and primitive tissues implicated in the wound. It is yet a question whether the ordinary circulation of the part, wholly unexcited or otherwise altered, is sufficient for the production of such euplastic fibrin ; or, whether the existence of the minor grade of the inflammatory process be essential. It is probable that the exudation is often the result of each form of vascular action. But, at all events, it is enough for the practical surgeon to know, that the required action is far short of that which constitutes what we consider to be true inflammation. If this ensue, organization of new product, and adhesion of original structure, are put in abeyance ; the exudation degenerates into pus, and the wound gapes even more widely than at first.

Some have supposed that blood may prove an organizable material, sufficient for adhesion ; and that the presence of a coagulum, between the cut surfaces, may consequently be conducive to adhesion. There is good reason to believe, however, that such is not the case ; that the red corpuscles, and probably the greater part of the fibrin too, constituting the coagulum, are absorbed ; and that the true plastic material is the result of a new, and as it were, special exudation. The fibrin is the agent of nutrition and repair ; the red corpuscles—the oxygen-carriers, and supporters of animal heat—are of little use but in the circulation, and minister to the function of respiration. Coagulum, when at all considerable, is a mechanical obstacle to the process of adhesion ; and, under such circumstances, is to be surgically considered a foreign body, offending, and to be removed.

2. *Wounds heal by growth* : a slow but most effectual mode of repair, analogous to the ordinary function of normal nutrition. This occurs in wounds which do not obtain coaptation of their cut surfaces, and which nevertheless do not inflame and suppurate, but retain a circulation the same as in ordinary health. A plastic exudation takes place on the surface, to a very limited extent ; not for the purpose of repair, but rather to constitute a covering or protection from atmospheric influence, exposure to which might, by its stimulus, hurry on vascular excitement. The surface assumes the appearance of mucous membrane, and distils a very scanty serous secretion. Beneath this, within the original textures, there advances a cellular development, as in ordinary nutrition, but at a more accelerated rate ; whereby the parts slowly and imperceptibly expand, so as to efface the breach which had previously existed. There is no deposit on the exterior, for the filling up of the gap by new structure exterior to the old ; all is done within the original

structure, and beneath the surface of the wound. This mode is common enough in the cold-blooded animals ; and, in all the lower animals, it is of more frequent occurrence than in the human subject. Its rarity in us depends on the proneness to vascular excitement which we possess ; more especially in a part which has been, even temporarily, exposed to an atmospheric influence with which it was previously unacquainted. But, rare though it be, it does occur ; and when it has taken place, the most perfect, stable, and satisfactory cure has thereby been obtained.

3. *Wounds heal* by what is termed "*the modelling process.*" Similar to the preceding, in being unaccompanied by inflammation and suppuration ; different, in consisting of a deposit of plastic matter from the surface of the wound, by which the gap is more rapidly filled ; portion being laid upon portion, without waste, after the manner of clay in the hands of the sculptor ; and hence the term. And yet, in truth, it more closely resembles adhesion. There is a similar exudation of plastic material, from and on the cut surface ; there is the same want of undue vascular action, just enough to afford sufficiency of plasma, and yet not interfering with the organization and vascularization of this ; there is the same absence of inflammation, and of the formation of pus. And yet it differs ; for the process occurs, not in a chink formed by a replaced wound, but in a gap which results from coaptation not having been effected. Again, also, comes a resemblance to the mode of repair by growth ; the air must be excluded. If this be effected by Nature, it is by a pellicle or crust having been early formed ; blood, or subsequent secretion, becoming dry and concrete ; adhering to the margins of the wound, and permitting merely the scanty aqueous secretion to pass outwards, which comes from the modelling surface, as from that which is of mucous character and protective of the healing by growth. If by art we would induce the process, we must similarly invest the surface, to the exclusion of air, either by artificially forming a crust—as by the nitrate of silver—or by adapting some suitable mechanical substitute.

The preceding modes of cure are painless, or nearly so ; effected by simple organization of plastic material, either within or without the cut surface ; inflammation is wholly absent ; there is no formation of pus ; there is no waste of the plastic material, all is employed in the purposes of repair ; a thin serous fluid exudes, and that in sparing quantity. Exclusion of the atmospheric air, from the cut surface, is essential to them all : in the first, this is effected by accurate and constant coaptation of the wound ; in the others, by a suitable investment of the part, either of natural or artificial construction.

4. *The fourth mode of healing* is by *granulation*, or "*union by the second intention ;*" a process formerly described, when treating of the closing of abscess. Preceded, but not accompanied by inflammation ; attended by suppuration, or partial waste of the fibrinous exudation ; completed by consolidation, contraction, and cicatrization.

Treatment.—*The treatment of wounds* has been greatly simplified, and improved, of late years. In the beginning of the seventeenth century, Cæsar Magatus, an Italian surgeon, exerted himself in this

way ; and, about a century later, Boccacini warmly supported the practice of his countryman, especially forbidding all greasy or oily applications. But, neither of these surgeons seem to have had many followers. And it was not until the middle of the eighteenth century, that our own Percival Pott, abolishing the maxim, "*Dolor medicina doloris* ;" explaining Nature's powers and mode of healing ; adapting surgical treatment so as to assist these ; discarding the painful and unnatural practices opposed to them, howsoever dignified and guarded by the cloak of antiquity ; and so establishing a system at once more rational and less severe :—achieved a most important reform in the practice of his profession. His immediate successor, the great John Hunter, by his valuable expositions of the natural processes in both health and disease, and more particularly of the doctrine of adhesion, confirmed the practical reforms of Pott, and stimulated the profession to cultivate and extend them. The gradual result has been, that, amongst other important improvements in surgery, the treatment of wounds has now become as efficient as it is simple and humane.

Simplicity, however—which may usually be considered as an index of the degree of perfection, in almost all surgical proceedings—is of very recent date. Within these few years, the dressings of wounds, though stripped of pain and cruelty, were unnecessarily numerous and complex, and likewise but ill calculated to forward the object for which they were employed. A routine system had been so long followed, that practitioners seemed never to dream of another. All wounds "were put together without delay ; and their edges, having been squeezed into apposition, were retained so by various means, such as sutures, plasters, compresses, and bandages. They were carefully covered up, and concealed from view, for a certain number of days. Then, the envelopes of cotton and flannel, the compress cloths, the pledgets of healing ointment, and plasters were taken away, loaded with putrid exhalations, and with a profusion of bloody, ill-digested, fœtid matter. A basin was forthwith held under the injured part, and the exposed and tender surface, having been deluged with water from a sponge, was well squeezed and wiped. Then came a re-application of retentive bandage, of the plaster, of the grease mixed with drying powder, all surmounted by some absorbent stuff, as charpie or tow, to soak up the discharge. This was not unaccompanied with pain—often more complained of than that attendant upon the original injury or operation. The process was repeated day after day. The patient was kept in a state of constant excitement ; and often, worn out by suffering, discharge, and hectic fever, he fell a victim to the practice. The system was a bad one—the applications filthy and abominable—the whole proceedings outraged nature and common sense. The wound was, as it were, put into a forcing bed ; excited action, beyond what was required, was hurried on, and the consequence was that speedy union seldom, if ever, could or did take place. On the contrary, a suppurating surface was formed, with profuse discharge ; and a very tedious cure, if any, was obtained."*

* Liston's Practical Surgery.

Treatment for Adhesion.—The hemorrhage having been stanch— and the wound cleansed, gently and carefully, from foreign matter, if need be—coaptation is to be thought of. And a question immediately arises, as to both when and how that is to be accomplished. Formerly, as has been already stated, it was the practice to make the coaptation both immediate and complete; but, now, temporary delay and incompleteness are deemed expedient. If the external wound be put together while oozing of blood continues, even though slightly, and more particularly if it be covered up by lint and bandaging, adhesion cannot but be thwarted. The blood, unable to escape, accumulates in a coagulum, which occupies the cavity of the wound, separating the cut surfaces to a greater or less extent; enacting the part of a foreign substance, as effectually as would lint, or charpie. Besides, the coagulum resembles a hot sponge, in contact with the cut vessels; and as the collateral circulation becomes more and more fully developed, in consequence of deligation of the principal arterial trunks, hemorrhage is most plainly favoured, from vessels which otherwise would have been permanently closed by the natural hæmostatics. Complete undoing of the coaptating means, exposure of the wound throughout its whole extent, removal of the interposed coagulum, arrest of the hemorrhage, and subsequent re-application of the dressing, become necessary; proceedings not only very painful to the patient, and irksome to the practitioner, but also most opposed to the occurrence of adhesion; for, a part so stimulated by fresh manipulation and injury, can scarcely escape inflammation. And, even should bleeding not occur to such an extent as to demand a re-opening of the wound for its arrest, still the mere lodgement of a coagulum forces on the inflammatory process, and suppuration becomes established. Seeking adhesion, it is our object to have no accumulation of clotted blood between the cut surfaces; to have no necessity arising, by hemorrhage, for re-opening the wound; and to avoid all exciting causes of true inflammation. These indications are fulfilled, by delaying all attempts at closure, for some time, in wounds of moderate extent; and, in those of large dimensions, as after amputation, making the immediate approximation only incomplete. The oozing thus escapes externally, without accumulating within; means are in operation to arrest it, namely, the application of styptic influence by atmospheric exposure, if not otherwise; and should a vessel prove troublesome, it can be secured, with comparatively little trouble or pain. In a large wound, one or two stitches are applied, if need be, to prevent exposure of the whole raw surface, and to facilitate the subsequent approximation. The minor wounds are untouched by needle, strap, or bandage. They are loosely covered with a thin portion of lint, wet in cold water; and, by its means, application of cold is made continuously, either by alternations of such pieces of wetted lint, or by irrigation.* By such treatment, not only is the oozing more speedily arrested, and

* The following is a convenient mode of applying the cold irrigation; by suspending a bottle of cold water in a suitable position as regards the part; "placing in it a few threads of lamp cotton, one extremity of which should reach to the bottom of the bottle, the other hang out at its mouth." In this way a species of syphon is obtained, with a constant dropping on the lint which invests the part.

the formation of an interposed coagulum prevented ; but, also, nervous and vascular excitement are repressed ; a rise towards true inflammation is opposed ; and the minor action, favourable to adhesion, is secured. Besides, the collateral circulation, tending to re-open the minor arterial orifices, is moderated ; and recurrence of bleeding rendered improbable.

After a time—in some cases, a few minutes, only suffice—all oozing ceases, and the cut surfaces become of a glazed appearance, the liquor sanguinis having already begun to exude ; the solid part remaining in contact with the wound, the serum trickling away. Then is the favourable opportunity for effecting complete coaptation ; without any foreign substance interposed between the cut surfaces, and with the plastic material of re-union already in process of formation. By longer delay, we should probably incur the risk of undue excitement, from atmospheric exposure.

And now the question arises, what is the preferable mode of effecting accurate apposition of the wound ? It is not the insertion of numerous, dragging stitches, the application of much impervious and irritating plaster, nor the pressure and heat of pledgets, compresses, and bandage. The object is not to pull, press, heat, hide, and irritate the parts, but simply to retain them in close yet easy contact. The principal agents of coaptation are, position, and plaster ; and, in very many wounds, these alone are quite sufficient. But, in others, where there is loss of substance—or when, from any other cause, approximation is not easily effected—sutures are indispensable ; otherwise the wound would gape, and could not adhere. The sutures are of what is termed the *interrupted* kind. A needle and thread are passed through the margins of the wound, so as to include the whole thickness of skin and a portion of cellular tissue, entering and emerging about a quarter of an inch from the line of incision. The thread is secured by a double knot, with sufficient tightness to make approximation complete at that point, yet not so tightly as to pucker the wound, or bruise the included textures. These sutures are to be as few in number as possible ; indicating and facilitating apposition, rather than effecting it ; and, in all cases, their use is temporary. By some, it is true, sutures are still wholly trusted to for coaptation. But it ought to be remembered, that living flesh is stitched, and not an inanimate garment ; that each suture is an injurious stimulus, prone to excite inflammation ; and that if such stimuli be numerous and permanent, in a short space of wound, inflammation is all but inevitable. The living structure fails not to resent the injury, and resists the lodgement of foreign matter in its substance. And, further, inflammation and suppuration of the wound itself, with delay of cure, constitute not the sole hazard ; erysipelas, or diffuse cellular infiltration, may ensue, requiring active and severe treatment, and, even with that, perilling existence.

As already stated, position, and plaster, are the main agents of apposition. The part is placed, comfortably yet securely, so as to relax those muscles whose fibres, on the stretch, would naturally impede the object in view. The surrounding skin having been gently freed from hair and moisture, the edges of the wound are carefully and gradually opposed

accurately to each other by the hands of an assistant, who retains them so, while the surgeon applies strips of adhesive plaster over the line of wound. The preferable kind of plaster is that brought into use by Mr. Liston, consisting of a strong solution of isinglass in spirit, spread evenly upon oiled silk, upon fine animal membrane, or upon silk gauze; the gauze is probably the best, first made water-proof by a coating of boiled oil, and then laid over with layers of the dissolved isinglass. The advantages of this kind of plaster are, that it does not irritate, while yet it adheres with much tenacity; on the one hand, not tending to encourage erysipelas, or inflammation of any kind; and, on the other, entailing no trouble to the surgeon, pain to the patient, or injury to the part, by frequent renewal; often, the first application remains firm throughout the whole period of cure. Another obvious and important advantage is, that the plaster, being translucent, permits a surveillance of the whole track of wound, as complete as if no dressing whatever had been employed. The slips should be long, in order that, enacting the part of a bandage, they may support the whole wound, and prevent falling away of the cut surfaces, in the deep, as well as in the superficial portion; and this is most especially necessary in large flap wounds, as after amputation. Interstices should also be left between each, in order to permit free escape of the slight serous discharge, which oozes out during the process of adhesion. Also, if sutures have been employed, these are left uncovered; in order to facilitate their subsequent removal. When, after some hours, the plaster has become consolidated, the sutures may be dispensed with, in whole or in part. If there have been a laxity of integument, with facility of apposition, they should be all gently removed, by section and withdrawal of each noose; but if there have been, and still is, some straining on the part, the removal of the sutures should as yet be but partial, or altogether deferred. It being at all times borne in mind, however, that the sooner they are removed—without displacement—the more likely is adhesion.

When the process advances favourably under this treatment—as it will do in the great majority of cases in which it can reasonably be expected—no other applications are required. All that is necessary has already been done; the wound is approximated, and retained so, under favourable circumstances; and farther covering of it would only tend to thwart the occurrence, which it is our wish to promote. All pledgets, cloths, and bandages, are therefore not to be thought of. It is sufficient to wipe away the fluid, which may exude from the dependent part of the wound, as often as is necessary. Thus, attention to cleanliness becomes the principal duty of the dresser in the after part of the cure; and, to facilitate this, the wound, when extensive, as after amputation, is placed on a sufficient portion of oiled silk, from which the secretion that trickles down can be wiped away without any soiling of the bed linen. It is scarcely necessary to add, that there should be no washing or rubbing, of either the wound or its immediate neighbourhood.

Towards the end of the cure, it often happens, in large wounds, that more or less œdematous swelling takes place in the edges and the surrounding parts; after amputation, for example, this is by no means

an unfrequent occurrence. To remove this, a plain bandage is necessary, lightly and uniformly applied, so as merely to support the parts, favouring absorption and venous return, without occasioning pressure or irritation. This is the first period when bandaging is really required; previously, its duty has been efficiently performed by the plaster. And this is the only addition to the simple treatment by plaster, that is likely to become either expedient or necessary when adhesion is the mode of healing.

So far, the manipulations of surgery are concerned. But the constitutional treatment is equally necessary; rest, quietude, and rigidly antiphlogistic regimen. The last indication is especially important; and yet is often either disregarded, or inefficiently fulfilled. Excess of vascular action is, in an approximated wound, the great enemy of adhesion; and, unless the regimen be kept of the most sparing kind, over action can hardly be avoided. Immediately after infliction of the wound, the patient should receive little or nothing, in the way of sustenance; and all hot or otherwise stimulating fluids should certainly be prohibited; otherwise, hemorrhage by re-action is favoured. And, subsequently, both food and drink should be kept on the truly antiphlogistic scale, so long as there is a wish for adhesion, and a probability of its occurrence. I am well satisfied, that if this dietetic part of the treatment of wounds were more carefully attended to, the occurrence of adhesion would be proportionally more frequent.

At the same time it is to be understood, that the system of starvation may be carried too far. Only during the first few days is it essential, while adhesion is yet probable; that having been attained, a gradual transition is made into more generous regimen; or, adhesion having failed, a similar transition is equally necessary, after the inflammatory crisis has been passed by. Be it remembered also, that, after severe operations, the antiphlogistic regimen ought always to be conducted with the greatest caution; for, it is probable that a tedious cure, by granulation, may eventually tax the powers of the system to the utmost.

A short time is sufficient for the establishment of adhesion. If it is to occur at all, it is certain within a week; three or four days ordinarily suffice. The cut margins are consolidated the one with the other; the line of wound is dry, and invested by a thin crust. If some of the sutures have not been previously removed, they should now be taken away; their occupation is gone; their presence will but entail suppuration and ulceration in the immediate vicinity of each noose—Nature's invariable effort for extrusion of the foreign substance—and if the inflammatory action spread, adhesion will be undone, and the wound gape as at first.

Parts which have been wholly severed from the body—as portions of fingers, of the nose, of the ears, &c.—have been re-adjusted with success. Under favourable circumstances, re-application may be made very carefully, retention secured by suture and plaster, and the treatment conducted for adhesion; but the part is more likely to slough than to live; and, when it does adhere, sensation often returns in a perverted form, causing much uneasiness.

Treatment for Granulation.—If adhesion fail, inflammation and sup-

puration become established. The margins of the wound swell, red-den, become painful, and tend to separate from each other; while from the chasm a more or less copious purulent secretion is discharged. Nothing can be worse in surgery, than the retention of sutures under such circumstances. The wound, by swelling, tends to open, but is thwarted by mechanical means; pus is formed, often copiously, and should be discharged freely, but this, by a mechanical and perverse shutting of the wound's mouth, is prevented; the parts are inflamed, and it is our object to moderate the inflammation, knowing well that until that has subsided the process of healing cannot be begun, but the continued stimulus of the strained sutures maintains and aggravates the untoward action. After a time, the noose ulcerates its own way out, and the part is relieved; but, ere this, much injury by over-action may have been sustained.

While all sutures, in an inflaming wound, are not only useless but injurious, and ought to be removed, the plasters may be allowed to remain. They yield a little, so as to permit the due amount of opening in the wound; yet still retain an approximating power, and prevent undue resilience of the edges. They are not only left undisturbed, but, when loosened by the discharge, are to be re-applied. The secretion is wiped up frequently; but no absorbing dressing is required; pledgets, compresses, and bandages, only heat and irritate the part, and enhance the over-action. If any thing be applied, the light and simple water-dressing is enough, of no greater extent than what is sufficient to cover the line of wound. After a time, this is medicated, by some gentle stimulant, as zinc; and, if need be, bandaging is employed.

There are many wounds, either altogether incapable of adhesion, or in which it is not to be expected; as those, with loss of substance, which cannot be approximated; and those which, from the lodgement of foreign matter, or other cause, can scarcely fail to inflame and sup-purate. In these, the treatment is precisely similar to that recom-mended in the treatment of abscess, after incision, and in the manage-ment of the simple suppurating ulcer. Here, the use of sutures is never expedient; it is worse than folly to drag and retain parts in contact, which cannot adhere, which must inflame and separate. We never attempt to make the coaptation complete; we would not have it so, were it in our power. The parts are simply replaced, and retained, as nearly as possible in their natural situation, by careful attention to position. In some cases, a strip or two of the isinglass plaster may be useful; as when a flap is loose, and threatens to be pendulous. Then the water-dressing is applied; at first cold, to suppress oozing; afterwards tepid, to prove comfortable to the part, and yet not favour return of bleeding. As the inflammation sets in, after some hours, it is gradu-ally made hot, and frequently renewed; in order to moderate the vas-cular action, relax the part, and favour secretion. As the inflammation subsides—as usually happens in a day or two, or less—the temperature is diminished, until the dressing is simply protective and detergent; to continue a high temperature then, would be to encourage the unto-ward relaxing and congestive effects formerly reprobated. As the gra-

nulating sore begins to evince symptoms of deficient action, the dressing is medicated, stimulant, in the ordinary way. Uniform support by bandaging, when suitable to the form of the part, is usually expedient, in these cases, from a comparatively early period. It must always, however, be employed with much caution. If pressure be had recourse to unnecessarily, if it be partially and unequally applied, if it be of undue severity, or if its use be unnecessarily prolonged, harm by over-action cannot fail to ensue, in any wound.

In some cases, the inflammatory action threatens to prove excessive, and may cause gangrene around the wound; thereby untowardly enlarging its extent, and protracting the cure. To avoid this, more active antiphlogistics are sometimes required; abstraction of blood from the part, and, it may be, from the system also; along with the other ordinary antiphlogistic means.

The constitutional treatment is in the first instance antiphlogistic—so long as the inflammatory stage persists—and proportioned in severity to the amount and kind of action. Towards the latter part of the cure, when suppuration is profuse, and contraction slow, a generous regimen becomes expedient; and even powerful tonics and stimuli may be required.

Sometimes the case may be so managed, that adhesion is ingrafted on granulation. For example, in deep suppurating wounds, as after amputation, which by fulness of their edges, admit of complete and easy approximation, the water-dressing may be discontinued under certain circumstances, and the plasters applied in the same manner as recommended for adhesion. This fortunate period is, when the suppurative inflammation has ceased, and when the vascular action is merely sufficient for the formation of healthy granulations. At this time the discharge is in very small quantity, and the divided surfaces are almost as prone to coalesce, firmly and permanently, as in the glazed condition, formerly spoken of, which occurs soon after cessation of the immediate hemorrhage. Consequently, when the watchful and judicious surgeon seizes upon this opportunity, and discontinuing his second-intention treatment, places and retains the parts in close and accurate apposition, it is more than probable that cohesion will then take place, speedily and effectually, by amalgamation of the granulating surfaces. If it fail, there is merely the trouble of removing or relaxing the retaining plasters, with the view of resuming the treatment by lint and oiled silk.

In the healing of all wounds, whether by the first or second intention, the importance of absolute rest of the injured part is very obvious. Without this, the reparative process must be constantly liable to interruption; it may have been most favourably commenced, Nature may seem most anxious to complete it, and yet all her best intentioned efforts may be frustrated by the negligent permission of movement. Motion of the body is often both requisite and allowable, for maintaining the general health, and will thus contribute somewhat to the cure; but all movement of the part itself is most prejudicial, and must be guarded against by every means in our power. Muscles must be kept relaxed and quiet; joints must be placed in a comfortable and convenient atti-

tude, and retained so ; and, to effect this latter object, it may sometimes be necessary to apply splints, so arranged as neither to make undue pressure on any injured part, nor interfere with the dressing and inspection of the wound. When this is so situated as to be under the bed-clothes, it is, of course, protected by a suitable cradle from their contact and pressure.

Treatment suitable to the Modelling Process, and the mode of healing by Growth.—The principles of such treatment are very simple ; but they are of comparatively limited application. They need be attempted only in wounds of slight extent, and in patients of no inflammatory tendency. In all wounds which can be approximated completely, adhesion is preferable ; not as forming a more efficient cicatrix—for in that respect it is inferior, at least to the latter—but as less liable to fail and lapse into suppuration.

The manual part of the treatment mainly consists in protecting the raw surface from atmospheric influence. Nature may effect this, by a crust of her own. And we may imitate this incrustation, in various ways ; by coagulating the juices on the part by a light application of the nitrate of silver ; by soaking a piece of lint, little larger than the wound, in the oozing blood, and permitting it to dry and harden on the part ; by laying on goldbeater's skin ; or by employing the tepid water-dressing, and renewing it seldom if at all. Of late, I have used, with success, in wounds suited to such modes of healing, a thick semifluid solution of gum tragacanth. It is laid gently and uniformly on the raw surface, so as completely to protect it ; and if at any portion the envelope threaten to become imperfect, the attendant is directed to effect an immediate repair. The application is productive of no irritation ; and, being translucent, permits a complete surveillance of the part. Atmospheric influence is completely excluded ; and the raw surface would seem to be placed in circumstances somewhat analogous to its normal state, as if still invested by the integument. Should inflammation ensue, no harm has been done ; on the contrary, the action is likely to prove less intense than it otherwise would have been ; the gum is loosened and washed away by the purulent secretion ; and the water-dressing may be then used, as in ordinary circumstances.

The constitutional treatment is antiphlogistic, rigidly enforced. In short, our object is to avoid all stimulus, both local and constitutional, and thereby to prevent the occurrence of inflammation. A very minor grade of vascular actions is what we desire, little if at all exalted above the normal standard.

Exceptions.—Such are the methods whereby the different modes of cure may be favoured ; nothing is actually done by surgery itself ; our art must rest contented with assisting, or at most directing, the workings of Nature. To the general rules there are found exceptions, as might naturally have been expected. The most prominent of these, is the use of *Twisted suture* in some wounds of the face, as for the cure of hare-lip. Here the rule of delay, previous to coaptation, is transgressed, and with impunity ; also, the sutures are permitted to remain, until adhesion has been supposed complete. A needle—a common sewing needle, or one made for the purpose with a flat steel point—is

made to transfix the margins of the wound ; and is retained. Around it a waxed ligature is passed, in the form of the figure 8 ; and, by this, the wound's margins are brought and retained in contact ; each needle having its own ligature ; if union or community of ligature be attempted, puckering of the edges is very likely to follow. In such a wound as that for hare-lip, two points of this suture usually suffice. At the end of two or three days, one needle is removed ; on the day after, the second is also gently loosened and taken away. But the twisted threads—by this time soaked, concrete, and adherent to the integument beneath—are left undisturbed.

Such wounds, whose superficial extent may vary, but whose depth is limited, admit of being retained in close and accurate contact at every point, so as to prevent the interposition of coagulated blood, or other obstacles to adhesion. Accordingly we find, that when they are brought together at once by the twisted suture, neatly and carefully applied, and when the needles are cautiously removed as early as prudence will allow, adhesion scarcely ever fails to occur. But if—in addition to the points of suture—plasters, pledgets, or other dressings be applied, the rule again becomes absolute, that multiplicity of investments are inimical to adhesion ; the wound will suppurate at one or more points, or throughout its whole extent.

In some situations, as about the nose, neither plasters nor the twisted suture can be used as retentive means. Then, as few points as possible of the common interrupted suture are to be inserted ; and they should all be cut out, as soon as adhesion has advanced so far as to render their retentive influence no longer absolutely necessary.

There are certain wounds—as in the vagina, and in the case of lacerated perineum—in regard to which it is by some supposed that the *Quilled* suture is the preferable means of retention. The whole track is, in every point, placed and maintained in accurate contact. Ligatures are passed, as in the interrupted suture ; but, instead of being secured in the ordinary way, the ends on each side of the wound are tied on a quill or portion of bougie, which is thus made to press the parts in apposition.

The *Continued*, or *Glover's suture*, is made by a fine needle and thread, as if on a piece of linen. It is only employed in the case of slight wound of intestine.

In large wounds, it may sometimes happen, that the treatment, such as we have recommended, fails in effecting coaptation throughout the whole extent ; that the deep walls separate, and that blood or matter tends to accumulate between. In such a case, it will be expedient to employ compress and bandaging, lightly applied, from the first.

Other instances of wound, in which the general rules of treatment must be either varied or transgressed, will occasionally occur in practice ; the peculiar circumstances of each will regulate the surgeon as to the treatment to be adopted. But even to them this general rule will be found applicable :—the less their management varies from the principles inculcated in the preceding pages—more particularly the all-important maxim of simplicity—the more likely will it be to prove suitable and efficient.

These principles may be briefly recapitulated as follows:—In regard to the adhesion of incised wounds; delay in approximation is advisable. Cold water-dressing is applied until bleeding has ceased. Then the wound may be closed; the cut surface having assumed a glazed appearance.

Delay and the cold applications are, besides, useful in preventing secondary hemorrhage. Should this occur, the open state of the wound is favourable to the adoption of means necessary for its arrest.

In effecting approximation, stitches may be employed when necessary; but they should be few, and in all cases their use is temporary. In a great number of instances they are entirely dispensed with. The principal and permanent retentive means are the slips of non-irritating isinglass plaster. And, as soon as these have become fixed in their hold, sutures are removed. The hare-lip operation, and some other wounds, are exceptions.

The isinglass plaster, being translucent, admits of a constant and complete surveillance of the uniting process in every part of the wound. It does not irritate the surface on which it is applied, is very adhesive, and seldom requires renewal during the cure.

No other dressing is applied. When coaptation has been effected and made permanent, all the manipulation necessary to adhesion is accomplished; dressing additional to the plaster, therefore, can do no good, may do harm, and are to be avoided. Cleanliness of the part, by gentle and occasional wiping, not of the wound, but of its neighbourhood, is all that is further requisite.

By this mode of dressing, the occurrence of adhesion is rendered much more probable; the patient is saved much pain and irritation, and the surgeon is freed from infinite trouble and annoyance. Should adhesion fail, the parts are in a more favourable state for assuming the other process of union, than they would have been, in similar circumstances, under the old system.

In regard to union by the second intention:—No stitches are employed. Approximation does not require to be complete; and the partial coaptation is made by simple replacement, and attention to position.

If intense inflammatory action follow the injury, active antiphlogistics must be resorted to, according to general principles.

Usually, water-dressing is the only application, unless during the latter part of the cure. At first cool, then gradually increased to antiphlogistic temperature, afterwards tepid and comfortable. When gentle stimulation of the granulating surface is required, towards the end of the cure, the water gives way to medicated solutions, proportioned in strength to the exigencies of the case.

Heavy, fœtid, cumbrous poultices, and greasy, rancid, irritating ointments, are superseded.

In the last stage of union, both by the first and by the second intention, and especially in the latter, support, with mild and uniform pressure, is not unfrequently advisable. It is effected by plaster, by bandage, or by both.

The process of union by the second intention, may sometimes be

dexterously supplanted by a semblance of adhesion. The period when this can be accomplished, is, when the vascular action has subsided from the inflammatory and suppurative to what is simply essential to reproduction. When the new and active granulations are then brought into close contact, they may quickly coalesce, a great part of the uniting process having been effected previous to apposition.

Two common and prominent exceptions to the preceding rules are, 1st. When the cut surface is such that every point can be placed in close and accurate contact, without the risk of coagulum or any other obstacle to adhesion being interposed; then, twisted sutures constitute the sole dressing. 2d. When the wound is so situated that neither plasters nor twisted sutures can be applied; then the common interrupted sutures must be employed, as few in number, and of as short duration, as possible.

The most prominent point, in the simplicity of the modern and improved treatment of wounds, is the employment of the water-dressing. It may not be uninteresting briefly to consider this, historically.

Hippocrates used water, cold and hot, as a local application; both in injury and in disease. But the simplicity and common sense of the old man of Cos were soon departed from, in favour of the farrago of vulnerary nonsense, invented by his less skilful and more conceited followers.

Paracelsus in his "Great Surgery," 1536, seemed to have a most just perception of things when he exclaimed, "Not without reason do I call Nature the physician of wounds!" And adds—"Warily must the surgeon take heed not to remove or interfere with Nature's balsam, but protect and defend it in its working and virtue. It is the nature of flesh to possess in itself an innate balsam which healeth wounds. Every limb has its own healing in itself; Nature has her own doctor in every limb: wherefore every chirurgeon should know, that it is not he, but Nature, who heals. What do wounds need? Nothing. Inasmuch as the flesh grows from within outwards, and not from without inwards; so the surgery of wound is a mere defensive, to prevent Nature from suffering any accident from without, so that she may proceed unchecked in her operations." Such sound maxims, however, were little, if at all, regarded by the profession; and it has been reserved for our day to see their full adoption.

During the siege of Metz, 1553, a quack, Maitre Doublet, "performed strange cures with simple white linen, and clear water from the fountains and wells; and every one went to him, as if he were Maitre Ambrose Paré himself—a man so celebrated, and considered the first of his day." Ambrose acknowledged the success, and imitated the practice; having at the same time the good sense to see that the real virtue lay in the "clear water," and not "in the mysterious words, and vain and unchristian ceremonies which M. Doublet made to accompany this new and singular practice." These, accordingly, he omitted.

In 1560, Gabriel Fallopius strongly recommended the use of water,

as a "fruitful source of success." In 1570, Palazzo wrote on the *true* method of curing wounds, by "simple water, hemp, and flax;" the temperature varying according to circumstances. In 1578, Laurent Joubert exposes the folly of charms, and contends that "common water is most efficacious in procuring a favourable termination, and a good cicatrix."

About this period, disputes were rife, whether incantation or the water was to have the credit of the cure; and, at last, the point was decided in favour of the water, by the Chancellor of the University of Montpellier.

In 1732, Lamorier published on the "use of common water in surgery;" contending that there were few wounds which could not be healed by this treatment, more promptly and satisfactorily than by any other means.

In 1785, a number of men, proving cannon at Strasbourg, were wounded by the bursting of the ordnance; and, in their case, the water-dressing proved very successful. A comparative trial was made of "blessed water" and simple water, without any appreciable difference being observed in the effects. Baron Percy was witness to this; and, becoming enamoured of the water system, employed little or nothing else in the treatment of wounds; protesting, that he "would relinquish military surgery, if he were prohibited from using water"—as a vulnerary.

Larrey, in the Egyptian campaign, used the waters of the Nile, in the treatment of wounds, with much success. Kern, of Vienna, strongly espoused the same cause, as also Breschet, Berard, and other celebrated surgeons. In Ireland, it met with an able and zealous supporter, in a late eminent practitioner; and the name of Matthew is not more associated with the use of the limpid element internally, than is that of Macartney with its external application. In this country, no one has laboured more successfully and zealously than Mr. Liston, in reprobating the "*nimia diligentia*" of the previous system of vulnerary manipulation; in establishing the claims of the simple water-dressing, both hot and cold; in carrying into practice, and illustrating the truth of, the maxims of Paracelsus, on this point—too long neglected; and in thereby conferring a great boon, both on the profession and on mankind.

On wounds made designedly, for surgical ends, the principles of cure have an important bearing. In the great majority of cases, it is our object that the wound shall heal in the most favourable way—by adhesion. Accordingly, it should be planned and made so as most to favour that occurrence. The knife used should have a keen edge, and be worked with little pressure; cutting with a sawing motion, rather than with a thrust; the object being to make a clean and smooth cut, devoid of bruise or laceration. We will not cut across the muscular fibres, but in a line parallel with their course; otherwise the wound will gape, and, even with force, approximation of the edges may be uncertain; by following the contrary practice, on the other hand, mere relaxation of the part will often be sufficient for the requisite apposition.

When the incisions are made for removal of a diseased or injured part of the body, we will endeavour to save as much of the external parts, more especially of the integument, as will admit of easy closure of the chasm. And, when the wound is deep, we will make its external part more extensive than the internal; in order that the secretions, which must form to a greater or less extent, may have free exit; so avoiding retention of these, separation of the wound's edges, obstruction of the adhesive process, consequent vascular excitement, and suppuration.

II. CONTUSED AND LACERATED WOUNDS.—These, closely resembling each other, in their nature, and in the treatment required, need not be considered separately. They are inflicted by a blunt body, forcibly applied, or by powerful divellent force; in the one case, the margins of the wound are bruised; in the other, torn, and of a ragged appearance. They are attended with comparatively little hemorrhage and pain: but are not the less formidable on that account. The lacerated artery, it will be remembered, accomplishes its own hæmostatics, with rapidity and ease; and when much bruising or tearing of the breached part has occurred, there is depression of the nervous as well as of all other vital function, and consequently but little sensation of pain. Were it to be imagined that, because a wound is neither painful nor inclined to bleed, it must be trivial, many and serious errors of diagnosis and prognosis would result.

Adhesion is impossible; inflammation and suppuration are certain. In the greater number of cases, the bruising and tearing are such, as either to kill a portion of the implicated texture outright, or so far to diminish its vital power as to render its speedy demission of life inevitable. That dead part must be thrown off, according to the general law; and, however slight the slough may be, its detachment cannot be effected without inflammation, suppuration, and ulceration. In severe cases, there is a double risk connected with the accession of gangrene. For, not only will there be loss of substance by the immediate sloughing; entailing much suppuration, risk by hectic, and tedious cure. But, besides, the gangrene may spread, either so as to invade and destroy a large extent of surface, enhancing the dangers just mentioned; or, involving the whole limb, it will throw the system into intense fever with prostration, and demand amputation.

The *treatment* is twofold in its object; to limit the accidents by inflammation and its results; and to favour granulation in the manner already described. The water-dressing is at first only cool; so as to arrest bleeding, and yet not increase the risk from gangrene by still farther depressing the vitality of the parts; afterwards it is hot, and conducted in the usual way. Not unfrequently, a large, soft, simple poultice, often renewed, is found very soothing to the part, during the inflammatory stage. In the severe cases, much judgment is required, to regulate the antiphlogistic means; more especially abstraction of blood from the part and from the system. On the one hand, we must be sufficiently active, to check an untoward amount and intensity of

inflammation, and so to limit loss of substance and constitutional disorder by extensive gangrene; on the other hand, we must be careful not to lower the system too far—remembering that suppuration, hectic, and it may be typhoid symptoms, are yet to come. Sutures are in no case necessary, and ought not to be applied; sufficiency of apposition is effected by replacement, attention to position, and the adhesive slips, if need be. During separation of the sloughs, hemorrhage may occur; the process, therefore, has to be watched anxiously. Should abscess form in the neighbourhood of the wound, or diffuse purulent infiltration be threatened, free incision should be practised early.

It is to be remembered, however, that all wounds inflicted by a blunt instrument are not necessarily of this second class. In some cases, they belong rather to the first, and require the same treatment. When an obtuse body, as a stick, stone, or bar of iron, is brought with smart violence in contact with integument placed over a resisting bone, as on the cranium, an apparently incised wound is not unfrequently the result; the same in appearance and general character as if inflicted leisurely by a knife. No doubt, the parts must be to a certain extent bruised; yet the bruise is not shown at the time, and may never be evinced at all—the wound healing readily enough by the first intention. The wound is partly incised, partly contused; but partakes much more of the former than of the latter character; and is to be treated accordingly, by close apposition, and with a view to adhesion.

III. PUNCTURED WOUNDS.—These are inflicted by the penetration of a sharp and pointed instrument, which bruises and tears as well as cuts. This class of wound, consequently, is of a compound nature. When, of any considerable extent, the injury is always serious. A long track of wound, superficially, involving little more than the integument and cellular tissue, is comparatively trivial; when, however, the direction is not along the surface, but towards the interior, there is always reason for apprehension. The danger is two-fold:—First, from injury done to important parts; as arteries, veins, nerves, canals, cavities, joints. Secondly, from inflammation occurring in the deep part of the wound, the purulent secretion being confined, diffuse infiltration being consequently rendered imminent, and much damage resulting to both part and system. The former danger is rendered probable by the form of the wound. Its nature favours the latter; for, being in part both contused and lacerated, a certain amount of inflammatory action is but too probable; especially in those cases in which blood has been infiltrated into the cellular tissue, in consequence of the form of the wound preventing its free exit. A third danger may be stated: from the chance of a part of the weapon breaking off, and remaining lodged in the depths of the wound; rendering inflammation there, and that of an intense character, inevitable.

Treatment.—At one time it was the invariable custom of the surgeon, as soon as satisfied that a wound was of the punctured kind, to dilate it freely, so as to give it an undoubted title to the appellation of incised; and it was thought that the patient was really benefited by such procedure. Such wanton cruelty, however, has now been justly

abandoned. Dilatation may be required; but often it is neither necessary nor expedient, in the first instance. The greater number of punctured wounds partake of the incised character, more largely than of the bruised and lacerated; and are to be treated accordingly. By inquiry into the history of the case, examination of the inflicting weapon, and the gentlest possible probing, if need be, it is ascertained that no foreign matter lodges in the wound. Apposition is then effected, gently and accurately; by attention to position, and use of the isinglass plaster. The part is kept at rest; and the system is placed under the antiphlogistic regimen. We look for adhesion, and frequently are not disappointed. Yet it is not unlikely to fail, for the reasons already stated; when it does, transition is made to the warm-water dressing, and other means suitable for mitigating the coming inflammation. If the action prove moderate, the discharge have free exit, and no swelling or hardness form deeply, there is yet no demand for dilatation. The ordinary treatment for granulation is carried out; and, by granulation, the aperture in due time closes.

Dilatation, however, may be most necessary under certain circumstances. 1. Hemorrhage may be serious, from a divided or punctured artery; and pressure either may have failed, or may seem inexpedient. In the original state of the wound, deligation is impracticable; yet the ligature must be applied. By incision, accordingly, the bleeding point is to be exposed, so as to admit of deligation being easily and securely performed. 2. A portion of the weapon, which inflicted the wound, may remain firmly imbedded in the deepest part. It may be necessary to dilate, to a certain extent, so as to permit the application of forceps, or other instruments, for extraction. 3. When by inflammation, deeply seated, and purulent secretion confined, diffuse infiltration is threatened; as indicated by deep pain and hardness, swelling of the whole wound, redness of the integuments, and violent constitutional disturbance; free incision cannot be too early employed. Then dilatation is essential to save structure, and to moderate serious disorder of the system. When fascia, or other tendinous texture, has been involved in the inflammation and infiltration, the case proves peculiarly troublesome, as can readily be imagined, and demands great energy of local treatment.

IV. POISONED WOUNDS.

By the experiments of Blake and others, it seems fully established that virus pervades the system through the blood, thence re-acting injuriously on the nervous system, and interfering more or less with all the functions of life. The effects are never instantaneous; a certain number of seconds, not less than nine, are requisite for the absorption, even of the most deadly poisons. Some of the more intense, as that of the most venomous serpents, would seem also to have a more direct influence on the nervous centres; probably by direct contact of the poison with the nerves of the part injured. Certain it is, that the nearer the injured part is to the brain, the more speedily are the untoward symptoms developed. But, even admitting that this direct nervous implication be true, it can only obtain to a comparatively slight

extent; and we are still forced to hold that the main agent of diffusion through the system is the circulating blood. For, it seems established, at least in the majority of cases, that the contact of poison with a large surface of the body, is not sufficient to give rise to general symptoms, so long as its general diffusion throughout the body, by the circulation, is prevented. It does not follow that the virus, when so diffused, shall affect all parts to an equal degree. On the contrary, it is found that certain tissues suffer in an especial manner; the nervous, pre-eminently.

When a virus has been introduced into the system, and is not speedily thereafter extruded by elimination, it is supposed that a process takes place in the blood, somewhat analogous to fermentation, and hence termed *Zymosis*; whereby the whole circulating fluid is deteriorated, and the poison at the same time multiplied, perhaps to a great extent. And this process varies very much, according to the poison, as to the time which is requisite for its completion.

Some poisons of much virulence, produce their deleterious, and perhaps fatal effects, at once, so soon as introduced by the blood into the system; as happens in the bites of the most venomous snakes. Others, again, do not exhibit their results, until the process of zymosis has been tardily completed; as in hydrophobia.

A third class of poisons—the venereal, for example—seem to have a doubly zymotic character. At first, the part is inoculated; and there the poison accumulates, by zymosis, forming the characteristic pustule and sore. Thence the system becomes contaminated, through absorption; and in the blood a second, or general zymotic process is effected, whence the secondary symptoms are produced.

(a.) *Poisoned Wounds by Dissection.*—Here the deleterious virus may be animal, engendered in the body previous to death, and as yet not altered by decomposition; as putrefaction advances, its virulence seems to be destroyed. This form is encountered in the dissection of females who have died from puerperal disease, for example; and inoculation, with such a virus, is a very formidable accident. Or the virus is the result of ordinary putrescence; and the inoculation of this is a less dangerous and infinitely more common occurrence. The injurious consequences are manifested, both in the part, and in the system.

I. LOCAL.—These, again, are either simple or severe. 1. *Simple.* A part is punctured, usually the finger; by a scalpel, needle, or projection of bone. The more ragged the puncture, and the less the bleeding therefrom, the more likely is the virus to lay hold of the part and be absorbed. After some hours, inflammation takes place, and a pustule forms at or near the puncture. The pustule gives way, discharging a thin, unhealthy, puriform fluid, and degenerates into an acute and painful ulcer. A minor action involves the integuments around, which are red, hot, painful, and slightly swollen; and, not unfrequently, this, spreading, establishes an erythema or simple erysipelas. This is the most common form of accident, and is of every day occurrence in the dissecting room.

Sometimes, a violent form of deep whitlow is induced; requiring incision, to prevent disorganization of texture. Sometimes, secondary

abscess collects in the axilla, of a chronic kind, without apparent affection of the intervening lymphatics. Sometimes, no acute action occurs at the site of the injury but a chronic induration forms, and is of long endurance.

2. *Severe*.—The inflammatory action is diffused from the first, and the pustular formation at the injured part may or may not occur. A genuine erysipelas is established. And, not unfrequently, angeioleucitis co-exists; evinced by red streaks, very painful, stretching continuously up the arm from the erysipelatous part; or by acute glandular enlargement in the axilla, connected with isolated patches of inflamed lymphatics on the inside of the limb. Abscess usually forms in the glands very speedily; perhaps accompanied with purulent infiltration of the surrounding cellular tissue. The latter casualty often occurs, also, in the cellular tissue on the corresponding side of the chest. Sometimes, the first symptom which attracts the patient's attention, is an intense pain in the shoulder, soon followed by glandular enlargement in the axilla, while yet the changes at the injured part are comparatively unimportant; when such is the case, diffuse cellular infiltration of the corresponding side is seldom absent, and usually extensive. Such local disasters, as can be readily understood, are invariably accompanied with intense constitutional disturbance.

II. GENERAL.—1. Derangement of the general health, without local injury, is not unfrequent; the poison entering the system by the skin, or by the lungs. This deleterious matter would seem also to be of two kinds; generated in the body before death, as in fever, and encountered in subjects recently dead; or the gaseous product of ordinary putrescence, emitted by any body much decomposed. From either form, the student seldom suffers, unless he be either very much exposed to the contagion, by long and habitual stay in the dissecting room, or predisposed to suffer thereby in consequence of previous disorder of the system. He feels feverish, languid, listless, and without appetite; the bowels become irregular, and diarrhœa sets in, accompanied with much flatulence; the gaseous product of the stomach and intestines is very fœtid, the fœtor closely resembling that of the dead body whence the deleterious influence has proceeded; and the same odour is also usually perceived in the mouth, in the breath, in the exhalations from the skin, and in the urine. The system seems saturated with the poison, and busy in freeing itself by elimination. After the diarrhœa has continued for sometime, perhaps accompanied with profuse perspiration at night, the symptoms usually abate; the greater part of the deleterious matter has been extruded, and the system rallies; unless the same cause be still in operation, through imprudent adherence to the dissecting room.

2. Constitutional symptoms of the gravest kind attend on the severe local affection; sometimes antecedent, sometimes consequent; most frequently the former, and becoming aggravated as the local affection is developed. At first, there is febrile disturbance of a simple kind; as the local changes form, the fever assumes the inflammatory type; but that usually is of short duration, and is merged in constitutional irritation of a very low kind, tending urgently towards typhoid prostration. In the minor local affection—pustule and erythema—the febrile dis-

turbance is but slight and simple. But in the more severe form, consisting of angeioleucitis, glandular abscess, and diffuse cellular infiltration, often complicated by erysipelas, the general symptoms are from the first of a most alarming nature, and place life in the most eminent peril. In some few cases, the precursory fever has been so intense, and yet of so low a type, as to carry off the patient even before any development of local disorder; as if by direct poisoning.

Treatment.—1. *For the local symptoms.*—Prevention is in our power, and ought never to be neglected. A wound, scratch, or puncture, however slight, having been received, the part should be immediately washed, and well-sucked by the mouth; which latter operation has the doubly beneficial effect, of both taking away the virus, and preventing the absorption of any small quantity which may for a time lurk in the part. At the same time, enlargement of the wound may be expedient. If it have been inflicted by the scalpel, and already show an inclination to bleed, increased by the suction, it need not be interfered with; but if it be a ragged scratch or puncture, from a pointed and edgeless substance, as a spiculum of bone, it is well to dilate it slightly by the point of a clean lancet or scalpel, so as to encourage the flow of blood, and thereby favour the washing away of the deleterious matter. After by washing, suction, and bleeding, a sufficient cleansing has been effected, the part should be touched lightly with the nitrate of silver; with two objects in view. The nitrate is supposed capable of effecting decomposition of any virus which may remain imbedded in the wounded part; and we know that it is most efficient in forming a protective crust, whereby the imbibition of other virus may be prevented. To fulfil more completely the latter indication, however, a piece of plaster is laid over the part, and the whole surrounded by some other envelope. Then dissection may be continued in security.

But a more important means of prevention exists, in regard to both the local and general symptoms; namely, attention to the general health. The robust student is seldom found to suffer, however many may be his dissection wounds, and however careless he may be of their local management. The stomach and bowels should be kept in a healthy state; diet should be generous yet temperate; a sufficiency of out-of-door exercise should be taken daily; clothing should be warm, and a clean perspirable state of the skin maintained; above all, late hours and every dissipation should be most carefully avoided.

Precautionary measures will of course be most attended to, under circumstances of especial danger. When the body is recent, and when death has proceeded from puerperal disease, particularly from affection of the serous membranes; and when the dissector is, from any cause, in indifferent health, and thereby predisposed to suffer from the virus.

When the local symptoms have become established, the treatment is according to general principles. The pustule is opened, and covered by a poultice, or by the warm-water dressing; the part is diligently fomented; and if angeioleucitis be threatened, the application of a warm and weak solution of the acetate of lead, with opium, will be found grateful. If erysipelas occur, or erythema prove troublesome, punctures by the lancet, with the view of local depletion, will be expedient.

If the erythema be but slight, light application of the nitrate of silver will suffice. When abscess has formed, and when diffuse infiltration threatens, free incision cannot be too early practised at the affected parts; in the latter case, it is only by incisions, almost deserving the term heroic, that disaster can be averted. The wounds are treated by water-dressing; and, at an early period, uniform and moderate support by bandaging should be afforded.

2. *For the general symptoms.*—In the first form—general derangement without local affection—application of the cause is plainly to be discontinued; that is, the dissecting room is to be left for a time, and the free open air enjoyed, as much as circumstances will permit. Also, the natural efforts towards extrusion of the deleterious matter are to be duly seconded; by purging, diaphoretics, and diuretics; but especially by the two first. There is a natural tendency to both diarrhœa and sweating; and, by suitable means, these are to be regulated and maintained, until the elimination seem to have been complete. Afterwards, a tonic system of treatment is to be enjoyed; more especially generous diet, and exercise in the open country air. Town-life, study, and dissection, need not be resumed, until convalescence is fully established. Usually, no long period of absence is required.

The constitutional symptoms of the second kind—those which attend on puncture, and the local accidents which result therefrom—are not so easily overcome. On their first accession, elimination is still to be attempted; by purging, full emesis, and diaphoresis; and these measures, at the same time, tend to moderate the febrile symptoms. During the short sthenic or inflammatory stage, gentle antiphlogistics are expedient; but general blood-letting, or other heroics, are seldom if ever warrantable. In the more urgent cases, calomel and opium, given so as to lay hold of the system, are sometimes beneficial. When suppuration has been fairly established, and especially if it be of the diffuse character, support, tonics, and stimuli, in their turn, are required; as in other examples of extreme constitutional irritation.

The more urgent cases are not unlikely to prove fatal. And those patients who escape with life, often retain but a shattered system ever after. They are liable to chronic suppurations, ulcers, and glandular enlargements; and to many other chronic disorders, of which debility is the prevailing type.

Affections of both part and system, in many respects resembling those arising from dissection wounds, not unfrequently occur in nurses or others who tend unwholesome sores, or who are employed in the washing of foul linen. Similar treatment is required.

(b.) *Poisoned Wounds by Healthy Animals.*

The Stings of Insects may be formidable by their number, by the susceptibility and state of system of the person injured, and by the nature of the part affected. Poison introduced by the stings of a horde of bees may be sufficient to overcome even the strongest individual; but such an intense and concentrated form of the injury is of rare occurrence. A less amount of injury, done to a young child, to a nervous

and delicate female, or to any one of temporarily reduced power, may be equally alarming in its effects. The sting of a solitary bee or wasp, in the fauces, as has sometimes happened to the incautious eaters of fruit, is likely to produce such an amount of acute swelling, as to threaten rapid asphyxia. But, ordinarily the stings of insects in this country are neither many nor serious.

In the first place, the part or parts should be carefully examined by means of a lens; and if the stings are found inserted, they should be carefully removed by finely pointed forceps. *Liquor potassæ* is supposed to have the effect of neutralizing the virus; the wound, consequently, may be wetted with this. Then, the best application, both in theory and practice, is the continuous use of cold; a remedy simple, effectual, and always within our reach. Constitutionally, restoratives may be required, at first, to remove the shock under which the patient may be found to labour; partly, from fright; partly physical, from introduction of the virus. Afterwards, calmatives to the nervous system, and gentle antiphlogistics, may be expedient, to subdue slight febrile excitement. In the formidable case of injury to the fauces, threatening asphyxia by rapid mucous swelling, scarification of the part, with fomentation outside and in, and the due amount of antiphlogistics, are required; employed actively. And should such means fail, tracheotomy ought to be unhesitatingly performed.

The Bites of Serpents, in hot climates, are extremely formidable. In this country they are comparatively trivial; man having no worse enemy, in this class, than the common viper; whose venom is sufficiently powerful to kill the smaller animals, but is fortunately almost inoperative upon the human subject. A person bitten is apt to be much alarmed; and requires restoratives and re-assurance, accordingly. The part swells, and becomes painful and red; undergoing a certain amount of the inflammatory process, but seldom attaining to true inflammation. The ordinary applications are expedient; continuous cold in the first instance, to moderate and arrest the action, if possible; failing which, fomentation, and the other antiphlogistics. The virus is of so weak and impotent a character, as regards man, that precaution need hardly be taken against absorption. The constitutional effects are slight, if any; the local may be accounted for, almost entirely, by the mechanical injury alone.

Though such be the general character of the results of such injuries, yet it is well to remember, that, in susceptible frames, the bites and stings of even the least poisonous creatures are not unfrequently followed by very troublesome consequences; angeioleucitis, abscess, perhaps eruption, and febrile disturbance.

Abroad, the accidents assume quite a different complexion. The bite of the rattle snake in America, and of the *Cobra de Capello* in India, is often followed by rapid dissolution. The poison, acting on the nervous centres, through the blood, as formerly explained, may speedily arrest their functions; and the patient dies of vital prostration; or, re-action having taken place, the disordered state of the blood induces febrile disturbance of a low kind, aggravated by the local changes

which meanwhile have occurred in the bitten part; and under this the patient may sink, at a more remote period.

The local affection is of itself formidable. By the absorption of virus into the blood, and its subsequent diffusion through the system, vital power is lowered generally. By imbibition of the poison in the part injured, the same result takes place locally. Under the stimulus of the injury, the part inflames; and the action, advancing uncontrolled, in consequence of deficiency both in general and in vital power, soon attains its worst results—gangrene, attended with diffuse infiltration of a putrid sanies. This, occurring in an otherwise sound patient, would itself induce constitutional disturbance of an alarming kind; but when the addition is made to a system already brought low, by the constitutional and almost immediate effect of the injury, it can readily be understood that the most dangerous consequences are likely to ensue.

Under such circumstances, the required activity of treatment is great; proportioned to the urgency of the case. The first and main indications are—to prevent absorption of the virus, and to obtain its expulsion from the part. With this view, a ligature is to be thrown instantly round the limb, between the heart and the bitten part, so as to obstruct return of venous blood from the latter. Thus, time is afforded for fulfilment of the second part of the indication; the expulsion of the virus. If the part be favourably situated, free excision should be instantly practised. If that be impracticable, free incision should be made, and the flow of blood encouraged by every means in our power. Suction by the mouth is suitable, after either excision or incision, with the view of both preventing absorption, and favouring the flow of blood, whereby the virus may be washed away. The application of a cupping-glass is at least equally efficient, and usually more suitable. It should be retained, not only during tendency to bleed, with the view of encouraging escape of blood and all other fluids from the part—but for hours afterwards; experiment having clearly proved, that, during their application, absorption takes place very slowly and imperfectly, if at all. Afterwards, it is well to apply the nitrate of silver freely to the part, for the same reasons as its use was recommended in the treatment of dissection wounds. When the diffuse infiltration has begun—as it speedily will, if we have failed in the timely and effectual expulsion of the virus—free incision is required, in order to arrest progress, save texture, and mitigate the general symptoms which would otherwise ensue.

The general treatment consists in the use of restoratives and stimuli in the first instance, in order to avert death by the immediate effects of the poison, and afford an opportunity for baffling its secondary effects also. Ammonia and arsenic are both high in repute, having been well spoken of by experience; the former proving useful, probably, as a powerful and suitable stimulus; the latter, perhaps, possessing some virtue as an antidote to the pernicious virus. The arsenic is given in large doses, and with impunity—one grain of the arsenious acid, or two drachms of the liquor arsenicalis; a tolerance of the remedy being plainly engendered. Its use is continued until free purging is induced. Thus it may also prove of service by elimination; and this may be further contributed to, by emetics and diaphoretics, according as the ral-

lied system will bear. Sometimes vomiting is spontaneous and excessive, tending to accelerate exhaustion of the patient; under such circumstances, it is to be moderated by opium, and the application of sinapisms to the epigastrium. The principal danger having been overcome, tonics, change of air, and generous diet, are indicated, to remove the remaining debility.

Many cases, as can be readily understood, prove fatal, ere assistance can be obtained. Others are seen too late for employment of the means suited to the prevention of absorption. In such, the attention is directed to the constitutional treatment—in order to obtain time for, and to assist in elimination—and to local management, by incision and otherwise, so as to limit the inflammatory accidents in the part.

(c.) *Poisoned wounds by diseased animals.*—The most prominent of these is the fearful malady which occasionally results from the bite of a rabid animal, and is termed *Hydrophobia*.

The disease, in the dog, is said to be of two forms. “The *first* is characterized by augmented activity of the sensorial and locomotive functions, continued and peculiar barking, and a strong disposition to bite. The affection commences with some alteration in the peculiar habits and disposition of the animal, who, as the case may be, is more irritable, more tractable, more lively, or more sluggish than usual; or these several conditions may alternate in one and the same animal. An early symptom consists in an inclination to lick, or carry in the mouth, various inedible substances, especially such as are cold. The animal after a time gets restless; snaps in the air, as if at flies; frequently leaves the house, but soon returns; and is obedient and seems attached to his master. According to Blaine, constipation constantly exists. There is usually complete loss of appetite; but the animal seems to suffer from thirst, drinking eagerly, until, as indeed usually occurs, the mouth and tongue become swollen. The eyes are red, and become dull, haggard, and half closed, the skin of the forehead being also wrinkled, which gives the animal a peculiar aspect. The nose, tongue, and throat, now usually become swollen, and the coat becomes rough and staring. According to Hertwig, the mouth is generally very dry; but Blaine has constantly observed a flow of thin saliva. After some time the gait becomes unsteady and staggering, and finally the extremities are paralyzed. The tail in this form of the disease, is not drawn between the legs; and the head is carried erect, the nose being pointed upwards. A disposition to bite, sooner or later, invariably occurs; it is not, however, permanent, but recurs periodically; is directed against both inanimate and animate objects; most especially against the cat, less so towards other animals, and least of all towards man. When the animal bites, he does not previously bark or fly at the object of his attack, but approaches in a quiet or even friendly manner, and makes a sudden snap.

“The *second* form of the disease is distinguished by inactivity and depression; there is no disposition to bite, probably from the lower jaw being paralyzed; nor is there any inclination for change of place manifested. The first symptoms are unusual quietness, and apparent de-

pression of spirits. The voice is peculiarly altered, as it is also in the foregoing variety, but there is much less disposition to bark. The mouth is open, the lower jaw hangs as if paralyzed, and is raised only under the influence of strong excitement; there is a constant flow of saliva from the mouth. The animal either does not drink at all, or does so with difficulty; but manifests no fear of water, and, on the contrary, willingly immerses the nose in that fluid. The tongue is almost constantly protruded from the mouth."* The animal rarely survives beyond the sixth day. Thus we see that dread of water, and insanity of the dog, are but vulgar errors, in connexion with this disease; some animals, indeed, trained to certain duties—as pointers—have performed these while in the rabid state, quite as efficiently as when unaffected.

The saliva of a dog labouring under such a disease, doubtless, contains a virus, the introduction of which by inoculation is capable of producing hydrophobia in the human subject; a disease so termed, not because there is truly a dread of water, but because, in man, the most prominent symptom is an inability to swallow, and unwillingness to attempt to swallow, any fluid whatever. Two points in regard to the virus of rabies are peculiar. First, a long period of latency exists; the symptoms of the disease, in man, seldom showing themselves sooner than the fortieth day after inoculation. Matured zymosis seems to be essential to production of the full influence of the poison. And it may be that a double zymosis takes place, as in the case of the venereal virus; first in the part, and afterwards in the system. Second; inoculation is not invariably followed by the untoward symptoms. A number of people may be bitten by the same animal; a few only—sometimes but one, sometimes none at all—fall victims to hydrophobia. The average is supposed to be one in twenty.

The virus of rabies is understood to be originally produced—but how, is yet uncertain—in the dog, fox, wolf, jackall, cat, and badger; and from them to be communicable by inoculation to many others. But it still remains an open question, whether or not these in their turn are capable of reproducing the disease; although the preponderance of evidence and belief, no doubt, leans toward the affirmative.

The most dangerous mode of injury is that by bite, on a part unprotected; as the hand or face. A bite through clothes is less formidable; inasmuch as it is probable, that the greater part of the virulent saliva has been entangled in the exterior of the cloth, and does not reach the wound. But, on the other hand, a bite is not essential. There may have previously existed a scratch, sore, or open surface of any kind; and, from the licking of this by a rabid animal, inoculation will be at least equally certain. The virus is inert on sound skin; also when taken internally, without breach of surface in the mucous passages.

Some authorities have been bold enough to deny, that hydrophobia ever occurs in the human subject; believing that what we term such is a simulation, of a nervous character, induced by dread and alarm. But this fancy is sufficiently disproved by the fact, that children have

* British and Foreign Medical Review. No. 25, p. 50.

been the victims of the disease ; as well as adults, who, from ignorance of the very existence of any such malady, could not have been amenable to the mental influence supposed. There is no doubt, that by anxiety of mind a nervous simulation may be induced, especially in females of hysterical tendency ; but this can readily be distinguished from the real disease, and is of an altogether different character as to its result ; seldom, if ever, proving fatal. Further, the mind undoubtedly has the power of not only hastening accession of the true disease, but also of effecting its aggravation.

The period of incubation—that is the period between the bite and accession of the direful symptoms—is, in man, invariably long, as already stated ; its average may be said to range between five and ten weeks. According to some, many years may elapse ; but a fallacy must have existed in such cases ; an intercurrent injury having doubtless been inflicted, though of so slight a nature as to have failed to attract attention. The symptoms of the disease are generally divided into two kinds ; the premonitory and actual.

1. The wound usually heals up in the ordinary way ; generally by granulation. But, after a time, pain and itching are felt in the cicatrix and its neighbourhood. The pain increases, and extends up the limb, usually in the course of the nerves ; unaccompanied by discolouration of the integument, except at the cicatrix, and not increased by pressure or motion ; it is neuralgic. The cicatrix becomes swollen and discoloured, and usually ulcerates, discharging a thin unhealthy pus. The general system shows disorder of a febrile character ; and marked headach supervenes ; with restlessness, disturbed dreamy sleep, increase of the shooting pains from the injured part, flying pains in other parts of the body, and other evident signs of much excitement of the whole nervous system. There is great acuteness of the senses, and of the intellectual functions ; memory is strong, imagination vivid and fertile, the countenance animated ; the eyes sparkling and clear, but intolerant of light. This state, however, is apt to be succeeded by dull despondency ; the result, probably, of mental depression and fear. The pulse is usually more frequent and strong than in health ; and yet not of the true inflammatory character. Then comes the dread of fluids ; completing the first stage ; the duration of which is short, never exceeding six days, and usually limited within two or three. In some cases, the premonitory class of symptoms do not occur, or at least are marked most imperfectly.

2. The second stage commences with a dread of fluids. Frightful agitation—accompanied with painful spasm of all the muscles of respiration, especially in the neck, and convulsive difficulty of breathing—is produced by even the sight of liquids ; by hearing fluids in motion, or poured from one vessel to another ; by the sudden contact of even a breath of cold air ; and by the idea of drinking. The patient, usually, is well aware of his state ; and, racked with a burning thirst, may try to overcome this instinctive aversion. Summoning a tremendous courage, he may make a dash at fluid, and obtain a mouthful ; but convulsions are sure to follow, most likely preventing deglutition of more than a few drops. Sleep is now lost entirely ; and the mind is strangely

altered. Despair has taken firm root, the patient considering his doom inevitable, and wishing to be relieved by death from his intense suffering; yet often talking with volubility and assumed ease, on subjects indifferent or trifling, in the vain attempt to conceal his real condition. Sometimes, the anxiety is obscured by no attempted concealment; and occasional screams attest the horror and suffering. The general surface is extremely irritable; the slightest impression on it exciting the paroxysms. And these are also produced, not only by the sight, hearing, and thought of fluids; but also by the sight or hearing of objects connected therewith, as cups, tea-spoons, &c. This hydropobia may remit for a time; in some few cases, an intermission has occurred, and swallowing of drink has been accomplished with comparative ease; but the amendment is deceptive; and the paroxysms recur in a more intense and enduring form. There is pain in the neck and throat; and pain in the epigastrium, and diaphragmatic region; often an occasional vomiting of dark, bilious matter. A thick tenacious sputum accumulates in the mouth and throat; and occasionally is seen frothy on the lips, in consequence of the difficult respiration; the attempts to dislodge it, by hawking and expectoration, are very frequent and distressing. The voice is changed, and hoarse; but it requires fancy to assimilate it to the barking of a dog. Occasionally, a croupy noise is made in inspiration, during spasmodic contraction of the glottis. Sometimes there is an inclination to bite; not, usually, from savage inclination; but involuntarily, and unwittingly; the patient often taking care to forewarn his attendants. Occasionally, a wild and fierce delirium is established.

As the disease advances, the cerebral excitement and disorder become more and more apparent. The eyes are staring, blood-shot, and never shut; hearing, sight, and touch, are wonderfully acute, but deceptive; speech is abrupt and rapid, and now incoherent; and at length delirium is confirmed. The paroxysms of difficult breathing, with spasm of the muscles of the throat, become more and more marked; in one of these the patient dies asphyxiated; or he sinks, exhausted, during a period of remission. And such is the second stage; usually of even shorter duration than the first. Sometimes, death is immediately preceded by complete remission of all the symptoms.

The morbid appearances, usually observed, are congestion, with serous effusion, in the brain and spinal cord, and their membranes. The mucous membrane of the stomach and fauces is highly increased in vascularity; that lining the air-passages is often in a similar state, and the lungs are much congested. The whole blood is dark and grumous.

Tetanus is the disease with which it is most apt to be confounded; yet the differences are sufficiently marked. The spasm of the muscles is more continued in tetanus; less remitting, and never intermitting. The jaw is usually much in motion in hydropobia, in consequence of frequent attempts to clear the mouth and throat from the peculiar tenacious mucus; in tetanus it is fixed. Tetanus is rarely attended with aversion to liquids; on the contrary, the bath is grateful; nor are the tetanic paroxysms increased by the sight, hearing, or touch of fluids.

Also, tetanus makes its accession usually at a much earlier period, after infliction of the injury. Physiologically, while tetanus is a disease of the true spinal system, hydrophobia involves the brain as well; as evinced by the disorder of intellectual function and special sense, even early in the disease. While in tetanus the stimulus, which excites the paroxysms, "operates through the true spinal cord, in hydrophobia, it is often conducted from the ganglia of special sense, or even from the brain; so that the sight or sound of fluids, or even the idea of them, occasions, equally with their contact, or with that of a current of air, the most distressing convulsions."*

The characteristics of the hydrophobic symptoms may be briefly stated, as follows:—They are paroxysmal, having marked remissions, and occasionally intermitting. Breathing and deglutition are the functions most prominently affected, by spasm of the muscles therewith connected. The external surface is extremely irritable. The intellectual functions are perverted, often from the first, but not truly deranged till near the close. The paroxysms are excitable by sight, hearing, touch, and mental function. The blood, deteriorated by the virus of rabies, injuriously affects the nervous centres; increasing their excitability to such an extent, that the slightest causes are sufficient to induce the most violent spasmodic actions.

Treatment.—The principal duty of the surgeon, in such cases, consists in adopting means for prevention; those of cure are but little within the reach of either science or art, even though the most consummately skilful. A person bitten under suspicious circumstances is usually much alarmed, and applies for relief without delay. Our first duty is to inquire into the history of the accident; the nature of the dog; its apparent condition at the time; whether loose or chained, whether provoked or not. For it may happen that the animal was not to blame, having been either provoked to an assault in its own way; or having inflicted the bite, with the idea of discharging a supposed duty, on an aggressor. Such a wound is not supposed to contain any virus, if the animal be apparently in sound health, and of its ordinary mood; no special treatment is required. If there be any reasonable grounds for doubt, however, let error always be approached on the safer side, and the treatment be conducted as if inoculation by virus had actually occurred. It is better that an unnecessary severity of treatment should be adopted, than that any risk should be incurred of the accession of an almost incurable disease. If the animal be undoubtedly rabid, it should be killed instantly, for very obvious reasons. If it be apparently well, and yet have inflicted the injury under suspicious circumstances, it is probably better to keep it in quarantine, but without the knowledge of the patient. If the animal become rabid, it should be put to death secretly; but if it remain well over the fifty days, usually allotted as the period of probation, it should be shown to the patient, as a most powerful means of re-assurance.

The surgeon, when satisfied that the bite has been inflicted by a rabid animal, at once proceeds to excision, when that is practicable; and

* Carpenter.

effects it in a thorough manner; carefully ascertaining the extent to which the teeth have pierced, and taking care that the knife goes beyond this on every aspect. Afterwards, it is well to apply the cupping glass, exhausted; so as to encourage bleeding and oppose absorption. If there be any uncertainty as to the whole of the injured parts having been removed, let caustic be applied freely; as before stated, it is better that the patient suffer pain unnecessarily, than that any portion of the virus should be permitted to remain. Some authorities prefer caustic to excision. Mr. Youatt, for example, reposes much faith in the nitrate of silver alone; and perhaps its chemical effect on the virus may be fully equal to its destructive action on the tissues, for the latter we know is but slight. His experience and his success have been great—400 cases of bite, by dogs undoubtedly rabid, and not one example of hydrophobia—yet excision is surely demanded of us, when practicable, as an additional and more effectual means of security; the nitrate being afterwards employed, if deemed necessary, to render assurance doubly sure. If the part be mangled in such a way, as to render it impossible to obtain accuracy in either excision or cauterization of the bitten parts; as sometimes happens to a finger, or even to a whole hand; amputation should certainly be performed.

Along with such local treatment, it is important that the general health be attended to. And, more especially, that every means be taken, by re-assurance, to maintain a state of mind free from anxious forebodings as to the result. As formerly observed, should an opportunity exist of showing the animal alive and well, that opportunity should never be neglected.

It has been said, that the bitten person generally loses no time in applying for surgical aid. But it sometimes happens that days have elapsed, ere the surgeon is consulted. And then arises a question, as to whether excision, at that period, is likely to afford a favourable chance of exemption; or whether the virus must have been already absorbed, and diffused throughout the system. This question can only be answered by experience; and experience has declared in favour of operation, even at a late period. The apparent success of such tardy operations may perhaps be explained by the fact, that all those bitten by animals truly rabid do not fall victims to the disease; but another explanation also offers itself, namely, that the local zymosis may not have been completed, and that, consequently, such excision may be in time to prevent the systemic diffusion.

Of the *curative treatment*, little can be said that is at all satisfactory. A few examples of recovery are on record; but they are only exceptions to the general rule. And, towards these recoveries, there is no striking proof that the treatment was especially conducive. There is scarcely any remedy which has not been tried; of the more important only it is necessary to speak, and that shortly. Bleeding and other active antiphlogistics have failed, after abundant trial. Bleeding is warrantable only in the robust, and at the very commencement of the disease; chiefly with the view of facilitating the operation of that class of remedies in which our trust will most naturally be placed—the calmatives of the nervous system. Opium, aconite, Indian hemp, belladonna,

hyoseyamus, are given in large doses, often repeated, as circumstances indicate and will permit. The solid form, of pill or bolus, may be swallowed, when the fluid cannot; and when deglutition in any way is found impossible, the skin, rectum, and veins, yet remain, whereby administration may be effected. The hydrophobic symptoms have a close resemblance to those induced by over-doses of strychnia; and aconite is reckoned the best antidote to this poison. To aconite, accordingly, the attention of the profession has lately been directed with an increased interest, in connexion with this disease. Magendie had observed, in experiments on animals, that nervous agency was remarkably subdued by injecting water into the veins, so as to induce an artificial aqueous plethora; and, we have already seen, that in hydrophobia the general mass of blood is black and grumous, palpably deficient in serum. Injection of water into the veins, therefore, is feasible in theory; in practice, it has been to a certain extent successful; and further repetition is assuredly warrantable, with the hope of alleviation, at all events, if not of cure; the operation, of course, being conducted with much caution, so as to guard against the dangers of phlebitis, and introduction of air. The spinal cord has naturally been attacked, in various ways. Instant vesication over the upper part of the spine, by ammonia, with the subsequent endermoid use of opium or other sedatives, has in some instances afforded decided relief; and is advisable. But a simpler sedative may be employed; namely, ice, in the large intestine of an animal, applied over the spine, and back of the head; the effects being carefully watched, however, lest the sedative result prove excessive, and fatal prostration ensue; and, further to counteract this, support by nourishment should be afforded at the same time; stimulants also being at hand, if required. Ice, too, may be kept in the mouth, as an additional sedative means, and a palliation of the raging thirst. The details of a case so treated, recently, in King's College, London, under Dr. Todd,* are such as to hold out no slight hopes of benefit, in further experience of the remedy.

During the administration of whatever remedies, it is obviously of much importance to keep the patient carefully secluded from all excitement, by light, noise, or otherwise; and to afford what nourishment is in our power—in order to palliate and protract, if we can neither avert nor cure.

Lately it has been proposed to perform tracheotomy, in order to avert asphyxia by spasmodic closure of the glottis; but, at the best, this can be only a palliative; and it is to be remembered that death frequently takes place, not from asphyxia, but, during remission of the spasm, from mere exhaustion.

(d.) *Inoculation of Virus, from a lower animal, not rabid, with or without wound.*

Equinia, or Glanders.—The horse, ass, and mule, are liable to a disease, which, according as it manifests itself chiefly in the lymphatic system, is termed *Farcy*—or in the nasal passages and skin, is termed *Glanders*. The virus, received into the human system, deranges the

* *Lancet*, No. 960, p. 583.

whole blood, as poisons usually do, and is capable of producing a series of symptoms closely analogous to the prototype in the lower animal. It is communicable both by contagion and by infection; but chiefly by the former mode. When the inoculation is by wound, the local symptoms precede the constitutional, and are such as follow poisoned wounds in general; angry inflammation of the part, angeioleucitis, erysipelas or erythema, and a tendency to diffuse infiltration of the cellular tissue—by some termed, not inappropriately, *cellulitis venenata*.

There is, at first, fever, of variable character; sometimes sthenic, more frequently asthenic in type; and soon followed by pains in the limbs and joints. "Hard, circumscribed, subcutaneous tumours form on the parts that are the seat of pain, in the vicinity of the joints or elsewhere on the extremities, or on the trunk. The skin covering the tumours may fall into gangrene, but they usually suppurate, and when opened generally yield a sanious or bloody discharge. Between the fourth and the sixteenth days, a nasal discharge appears; not, however, uniformly. In some cases, this symptom is only apparently absent; pressure causing a discharge from the nose, or decubitus causing it to run into the mouth. The discharge is usually from both nostrils, is rarely abundant, is yellowish, viscid, and sometimes purulent and streaked with blood. The nose and adjacent parts are occasionally swollen; and in two cases gangrene of the nose occurred. At an uncertain period of the malady—at a mean term, perhaps on the twelfth day—a principal and remarkable symptom occurs, which consists in the appearance of a pustular eruption, or gangrenous bullæ, on the face, trunk, extremities, or genital organs. The pustules appear in succession, and usually occupy the face, arms, thighs, and anterior surface of the trunk; they have been compared to the pustules of small-pox, but their appearance is peculiar and specific. The bullæ may be followed by gangrene, varying in extent and depth. Whatever the original type of the fever may have been, it now becomes of a typhoid or adynamic character. The duration of the disease is short. In two-thirds of the cases, death occurred before the seventeenth day; one only survived on the fifty-ninth day."* As yet, the fatality has been almost without exception.

The disease may be either acute or chronic, in its general character; the symptoms and appearances varying accordingly. The chronic form can scarcely be said to invite higher hopes of recovery.

When there is an absence of nasal discharge, and of pustules or ulcers in the schneiderian membrane; and when not only the characteristic eruption is present, but also numerous, soft, doughy tumours form in various parts of the surface, remote from the point of inoculation, usually on the extremities; and when these tumours are seldom resolved, but almost constantly suppurate, and sometimes pass into gangrene—large subcutaneous abscesses, also, sometimes forming in the limbs—the disease may be termed Farcy; chronic or acute, according to circumstances.

The means of prevention are sufficiently obvious. Those of cure

* British and Foreign Review. No. 25, p. 33.

consist in a mitigation of symptoms ; by fomentation, poultice, or water-dressing, of sores and pustules ; evacuation of abscesses, and free incision of infiltrated cellular tissue ; the use of chlorides as correctives of fætor ; applications of various alteratives to the sores, as their appearances may indicate ; and supporting the general strength by diet and stimuli, as circumstances may require. The alterative said to be most suitable for application to the sores, is creasote in solution.

The Malignant Pustule, or Vesicle, may also occur with or without breach of surface ; but only by contagion. And, of course, inoculation is the more rapid and certain means of communicating the disease. It shows itself chiefly in low marshy situations, in which cattle abound ; and is caused by virus communicated from animals affected with typhoid disease, of which the formation of carbuncles is usually a prominent symptom. The animal may be either dead or alive ; the cuticle may be either entire or abraded. Some have asserted that the tainted flesh taken internally, as food, will produce the disease ; no doubt, serious constitutional disorder, probably of a typhoid character, will in all likelihood occur under such circumstances, and the skin may become affected by an eruption, probably degenerating into troublesome sores ; yet the malignant pustule in truth does not form, as by inoculation. At all events, it yet requires to be proved that the disease is communicable either by eating diseased flesh, or by inhalation of tainted atmosphere ; and, meanwhile, probability leans much towards the negative.

The disease, as occurring in the human subject, may be divided into three periods ; according to the extent to which the virus has involved the tissues. 1. It is seated in the mere surface of the skin. The characters are, itching, the formation of a dark vesicle, and discharge of a brownish fluid. 2. The true skin is altogether involved. And the characters are :—the formation of a hard, painful tubercle ; enclosure of the vesicle in a dark areola of vascular action ; and increase of anomalous sensation in the part. 3. The subcutaneous cellular tissue is implicated. All the local symptoms are increased ; swelling is great and tense ; pain is hot and burning ; the vesicle has burst, and discloses a sloughing phagedæna ; and this extends with more or less rapidity. By this time, also, the system has become fully contaminated ; fever of a marked typhoid character sets in, and may rapidly carry off the patient.

The hands, being the parts most liable to contact of the deleterious matter, are the most frequent seat of the disorder. The persons most commonly affected are butchers, tanners, and others whose occupation brings them into contact with animals, or animal remains.

The indications of treatment are, to arrest the action of the putrid virus, and to avert or diminish the constitutional result. The part is to be destroyed, at as early a period as possible, by an escharotic ; the potential is preferable to the actual cautery ; and, of the former, nitric acid and the potassa fusa are the most suitable. Separation of the slough is watched ; and should the subjacent parts seem still unsatisfactory, the caustic should be re-applied, freely, without delay. Bleed-

ing, at whatever stage, invariably accelerates and aggravates the general symptoms, and usually ensures a fatal issue. Tonics and stimuli, regulated by circumstances, must be given from the first. Of the former, quinine is generally preferred in large doses; of the latter, ammonia.

V. GUNSHOT WOUNDS.—This term is applied to injuries inflicted by musket or cannon-shot, by splinters on board of ship, by stones in garrison, and by the bursting of shells, &c. In military practice, they are of much more frequent occurrence than wounds of either an incised or punctured character, by sword or bayonet; the bayonet thrusts are the most rare, that weapon being but seldom crossed in fight; the sabre tells in the cavalry charge; but “these vile guns” are the paramount consumers of human blood and life.

Gunshot wounds are always more or less of the contused and lacerated character; followed by sloughing and suppuration; and never healing but by the second intention. The sloughing is in part the immediate result, partly secondary, from excess of action over power, as in other contusions. Hemorrhage is seldom great, unless a large artery be directly implicated. But, gunshot injury being generally extensive and arteries of some considerable size consequently certain to be more or less wounded, danger is not slight from direct loss of blood. Often, from the form and extent of wound, little blood may show externally, while a fatal hemorrhage is advancing in the interior. The extent of injury is very various. A ball may merely graze the part, scarcely inflicting a flesh bruise; or it may impinge, so as to fracture bone, without division of the integument; it may enter a part and lodge; or it may effect a complete perforation; a limb may be carried away, as if by a rude amputation; or it may be pounded almost to a jelly, yet remaining in contact with the living trunk. The cannon-ball seldom lodges. Round shot have been found imbedded in the glutei, or even in less fleshy parts; but the occurrence is rare. Lodgement of the musket bullet, on the contrary, is extremely common. The aperture made by the bullet's entrance is small, and with the margins inverted; often, it appears of much less dimensions than the foreign body which has passed through it, and may even simulate the incised character; in such cases, the ball has come from some distance, and has struck with considerable force and velocity; the aperture, consequently, is made with comparatively little bruising or tearing, and the resilient textures close upon its track. The aperture of exit, on the contrary, has its margins ragged and everted, and is invariably of larger dimensions than that which marks the entrance. When the injury has been inflicted at a short distance, the aperture of entrance is comparatively large, has no smoothness in its edges, and is obviously of a lacerated character; portions of the wadding are usually impacted in some part of the track; and the surface may be marked by the grains of powder.

The pain of a mere flesh wound is often slight; the patient, if actively engaged, may hardly be aware that he has sustained injury. If a bone be broken, or a large nerve torn, however, the pain is usually severe, and demands instant attention.

The shock, too, varies. As in other injuries, it may be of two kinds;

mental and corporeal. The former is temporary, may exist without any serious injury, and ordinarily gives way before re-assurance. The latter may be aggravated by the former; but is itself wholly independent of the mind. The bravest, and the most actively employed, are laid prostrate by it. It is proportioned to the extent of the injury, and the importance of the part affected. If a limb has been carried away by a round shot; or if an internal organ, as the lungs, stomach, liver, have been implicated in the course of a bullet; the patient is found in a state more or less approaching to syncope, and struck with an alarm and apprehension, over which he has no control. Whereas, by a simple fracture or flesh wound, the same patient would scarcely be disturbed from his ordinary composure. Sometimes, however, a considerable amount of corporeal and actual shock does attend even on slight injury; in this case, however, it is transient; either quickly passing off spontaneously, or yielding readily to the ordinary restoratives. But when, in a case of apparently slight wound, we find much depression of system, which refuses to yield, we may be tolerably certain that what before seemed trivial is in truth severe, and that some internal organ has been seriously implicated.

At one time, it was supposed that a shock, sufficient to cause instant death, might be sustained from the mere concussion produced by a large shot passing with great rapidity and closeness, yet without actually touching the body; and that laceration of muscles and arteries, with fracture of bones, might be occasioned in a similar way. But it is now well understood, that these are not the effects of mere "wind contusions," as they were termed; but are produced by spent balls, which have really struck—yet with so little quickness of force, as to merely bruise, without inflicting an open wound. An internal cavity, as of the cranium, may sustain even a fatal concussion by the contact of a spent shot, without any signs of an outward bruise; but, usually, the signs of contusion are both extensive and apparent. A cannon-ball, when first projected, passes in a straight course; but soon it assumes a curvilinear, paraboloid direction; and at the same time it rotates on its own axis—this rotation increasing with the increased distance, and the diminished velocity. Sweeping or penetrating wounds are likely to follow obstruction to the first part of its course; while, in its last stage, it may merely roll round or over the part, as a wheel passes over a limb. Attention to this circumstance tends to explain the occurrence of such latent injuries, as well as to account for the extraordinarily circuitous routes sometimes taken by musket bullets which perforate.

The course of bullets is at all times uncertain. A very slight obstacle suffices to cause diversion from the rectilinear direction—as evidenced by the rebounding of round shot from water. "A button, a watch, a book, or a handkerchief, has been the means of preserving life," from the musket bullet. And a succession of such obstacles may occasion a most devious track. The aperture of exit may be found very close to that of entrance; and yet the bullet may have nearly completed the circuit of the body. Or a ball may strike the forehead, and emerge at a point directly opposite, in the occiput; as if it had perforated the cranium in a straight line, while in truth it has never

been deeper than the integument. In such cases, the superficial track is marked by a discoloured elevation, sometimes slightly emphysematous. In deeply penetrating wounds, the course may be equally unexpected; bone, muscle, fascia, proving the agents of diversion. A ball has entered the breast, and lodged in the scrotum; a ball may penetrate at the upper part of the breast in front, and lodge near the spine at a much lower plane. "In one instance which occurred in a soldier with his arm extended, in the act of endeavouring to climb up a scaling ladder, a ball, which entered about the centre of the humerus, passed along the limb, and over the posterior part of the thorax, coursed among the abdominal muscles, dipped deep through the glutei, and presented on the fore part of the opposite thigh, about midway down."*

As already stated, the nature of the wound depends on the distance at which the shot has been fired, on the nature of the foreign body, and on the force with which it has come. At a short distance, powder will penetrate, by its grains, as well as burn by its explosion. At a greater, yet still limited distance, wadding will penetrate, and may inflict a ghastly lacerated wound—a circumstance often not attended to by the vulgar; lives have not seldom been lost by the reckless discharge, at close distances, of fire-arms supposed to be harmless because loaded only with powder and wadding. At a short distance, small shot, as in the common fowling piece, penetrate in a mass, like a bullet; at a considerable distance, the charge scatters, and inflicts a more extensive but less deadly wound. A bullet, when near, passes tearing into the flesh; when discharged more remotely, yet still moving with velocity, its wound is smaller and more incised; when of very distant origin, it may bruise muscle and break bone, without penetrating or even wounding the integument. Slugs, and irregular portions of iron, necessarily make more extensive and serious wounds than those inflicted by bullets. The latter, impinging on bone, are apt to be flattened or otherwise altered in shape; when so altered, they may either pass onwards into the flesh, or remain imbedded in the bone. On a sharp ridge of bone, a bullet may be bisected; and each half, passing onwards, may perforate; giving rise to two apertures of exit.

Pellets, and bullets unaltered from their smooth rounded form, may lodge in a fleshy part without creating much disturbance. The wound closes in the ordinary way, and perhaps about the ordinary time; the foreign body becomes surrounded by an adventitious cyst of a quasiserous character; and may there remain for years, undisturbed, or moving occasionally from place to place; causing but little uneasiness, excepting during atmospheric change—when pain, sense of weight, and general discomfort in the part, are apt to assume somewhat of a barometric character. Sharp, irregular bodies, however, are seldom so tractable; the surrounding parts will not tolerate their presence; suppuration is profuse and continued; inflammatory re-accessions are frequent; Nature is constantly reiterating her effort of extrusion; and quietude and closure are not obtained, until the offending substance has been dislodged and taken away. Sometimes, the inflammation ceases, the wound contracts, and the discharge diminishes; yet a sinus

remains, communicating with the foreign body, as if indicating and waiting for its passage outwards. In this case, the bullet has an envelope of a membranous character ; but not shut and serous-like, as in the former case ; rather mucous, and with an outlet.

Clothing may either prevent the ball's entrance, or enter and lodge along with it. A portion of shirt or handkerchief, for example, may be carried before a bullet, with its continuity unbroken, and become impacted in the wound. On pulling out the invaginated portion of dress, the bullet will roll out from its interior. Or the clothing may be cut up, and driven inwards in portions ; and these are likely to lodge, while the ball may perforate and escape. Other foreign bodies, too, or substances which come to enact the part of such, may lodge, and untowardly complicate the wound ; as portions of earth, stone, wood, and splinters of fractured bone. Portions of the clothing, accoutrements, and even of the body, of one soldier, may be impacted in the wound of his comrade.

Bone may be merely fractured ; the injury being compound, but neither comminuted nor complicated. Or it may be broken up into many portions of a spiculated character. Or it may be simply perforated, with longitudinal fissure extending more or less widely from the aperture. Or a ball may penetrate only the external part ; and lodge in the cancelli, leaving the general continuity of the bone unbroken. Projected very slowly, the ball may merely bruise the bone. But such bruise is apt to prove troublesome ; exciting inflammatory action in a part of diminished power, and so greatly favouring the induction of necrosis. Gunshot injury of bone, indeed, of whatever kind, is always of an unfavourable character, and prone to necrosis ; being attended with much bruising of the tissue. Joints may be simply opened up ; or, in addition, may have their interior occupied by foreign matter.

The indications of a ball, or other foreign body, having escaped, are not always plain. If there be but one aperture, that of entrance, the natural inference is, that lodgement has taken place. Yet there is an exception to this ; when the ball has been lodged in a portion of the clothing carried before it, and has escaped on the evulsion of that portion at the time of undressing the patient ; also, when the ball has made a complete circuit, and come out at the same spot at which it entered—as has occasionally happened. When, on the contrary, there is plainly the aperture of exit as well as that of entrance—and the two nearly in a straight line, or otherwise placed as circumstances would seem to render likely—the probability is that the ball has perforated and escaped. And yet we may be mistaken ; for it may have been divided on bone, as formerly remarked, and one part only may have escaped, while the other remains impacted. Or two apertures, nearly in a line, may both be of entrance, and made by two distinct balls, which have lodged. Also, a plurality of openings does not imply a plurality of bullets. The same bullet may perforate and escape, and perforate again ; or, after perforation, it may be subdivided into two or more fragments, and each have its separate aperture of exit.

The true extent and danger of a gunshot wound can scarcely be determined, until suppuration has been established. Then the sloughs

become detached ; not necessarily involving the whole track ; greatest usually at the point of entrance. And, on separation of the sloughs, bones, joints, arteries, cavities, and canals, may be exposed, which previously were deemed unimplicated.

The accidents which are liable to occur during the progress of cure, are many and formidable ; excess of inflammation, and of inflammatory fever ; erysipelas ; abscess, after abscess, by inflammatory re-accession, probably connected with the lodgement of foreign matter ; diffuse purulent infiltration ; inflammation of veins, either in the hard or soft textures, perhaps of the diffuse and suppurative kind ; untoward extension or recurrence of sloughing ; hemorrhage on the separation of sloughs, or by subsequent ulceration ; accession of sloughing phagedæna ; non-union of fracture ; necrosis ; caries ; exhaustion by hectic ; tetanus.

Treatment.—Gunshot wounds are amenable to the general rules of treatment adapted to the contused and lacerated wounds in general ; the leading indications being :—to watch, and if necessary, to expedite, disappearance of the shock ; to remove foreign matter ; to re-adjust the parts, and place them in a comfortable and relaxed position ; to moderate the coming inflammation ; to promote the separation of sloughs ; to favour the contraction and consolidation of the wound ; constitutionally, to moderate the effects of local over-action, in the first instance, and subsequently to support the frame for the perhaps protracted efforts of repair. The accidents, when they threaten or occur, are to be met by the ordinary means. It is obviously of much importance, to ascertain at the outset whether foreign matter has lodged or not. This is effected by gentle yet determined probing, and manipulation of the wounded parts ; it being well to place the patient, during such examination, in the position which he occupied at the time of the injury, and then to reason on the most likely course of the bullet. When the foreign body is felt plainly in the track of the wound, it is to be removed immediately, by the finger or forceps ; the wound being dilated, if need be. If found superficially lodged beneath the integument, it is to be cut down upon and taken away. But if found deep and firmly impacted, it is well to wait for the suppurative stage ; and, during the relaxation of texture attendant thereon, to make the attempt at removal—at a time when the foreign body itself, in obedience to the general law, has begun to seek the surface. In regard to bullets deeply lodged, it ought also to be remembered ; that they may become encysted and quiescent, giving little or no uneasiness, and may remain so for years ; or that, at some future period, they may approach the surface, and ultimately, as it were, invite their own removal.

But, very frequently, the surgeon's first care is to determine, whether the injured limb is to remain, or whether amputation be not expedient. The settlement of this question will be mainly influenced, by the probability of the occurrence of gangrene ; by regard to the power of the system in the prospect of a tedious and suppurative cure, as influenced by age, habits, and previous condition ; by the probability of the limb proving useful, or otherwise, if retained ; and by regard to the disposable means for conducting the treatment.

If it be determined to remove the limb, a second question arises as

to the proper time for doing so; whether the amputation shall be primary, performed before inflammatory accession; or secondary, after the suppurative stage has been established, with decadence of the constitutional inflammatory symptoms. In military practice, there is now little diversity of opinion on this subject; decided preference, for very obvious reasons, being given to the primary operation. The shock having passed off—as usually happens within a few hours—the part is taken away during the interval of systemic repose, between depression and excessive re-action, a period whose average range is from eight to sixteen hours. The mangled limb is converted into a simple flesh wound; and the dangers of gangrene, high inflammatory fever, and hectic, are removed by anticipation.

Certain circumstances are usually understood to render the performance of amputation either essential or expedient. 1. When a limb has been carried away, leaving a shattered and unseemly stump. To refrain from amputation in such a case, were willingly to encounter the immediate risk by gangrene; the subsequent danger, by hectic, under a wasting and long protracted suppuration; and the certainty of the stump, even when healed, proving unserviceable. 2. When a limb has been struck by a shot, and shattered, although not carried away; when bones are broken, blood-vessels and nerves torn, and muscles bruised to disorganization; gangrene is inevitable, and operation imperative. 3. When a mass of the soft parts has been carried away, involving the principal vessels, yet without injury to the bone; or when, the main vessels remaining entire, the rest of the limb is hopelessly shattered and bruised; still gangrene is certain, and amputation demanded. 4. When the part is crushed to disorganization, without wound of the integument; as by a spent ball; a state evidenced by the pulpy, loose feel, coldness, and impaired sensibility of the part. 5. When joints are opened, and the bones composing them broken. This applies almost without reservation to the hip, knee, and ankle joints. But the joints of the upper extremity are in many cases exempt, and seldom afford an unqualified indication for immediate removal; there being in this part of the body a much greater tolerance of injury, and power of repair. 6. Compound fractures of the thigh, more especially at its upper part, are usually found to proceed untowardly; and, therefore, the majority of such cases are held to demand primary amputation.

However plainly the local injury may render amputation necessary, it is obvious that the operation should not be performed unless there exist a reasonable prospect of success. For example, if a patient be mortally wounded in an internal organ, besides having sustained severe injury of a limb, it was sad surgery to shorten his doomed life by the exhaustion of an operation directed towards the lesser evil.

Secondary amputation becomes imperative, in the case of a limb which we had hoped to save, when spreading gangrene occurs, or when the frame is obviously yielding under an otherwise uncontrollable hectic. A second amputation may also be rendered expedient, when the stump which resulted from the first operation proves unsatisfactory; in consequence of sloughing or ulceration of the soft parts, or exfoliation of the bone.

The occurrence of tetanus may be held a warrant for amputation ; if so, the operation should be performed at an early period of the disease.

The secondary amputations usually prove more successful in civil than in military practice ; a circumstance to be explained by the superior accommodation and convenience for treatment.

VI. Perhaps a sixth class of wounds may be said to be the SUBCUTANEOUS ; which belong to the class of incised, but are peculiar in their mode of production. They are designedly made, by the hand of the surgeon, with some curative object in view. Their paramount principle is, the thorough exclusion of atmospheric air from the cut part. By the absence of such stimulus, inflammation is avoided ; and union occurs by adhesion ; without pain or pus, and within few days after infliction. A narrow knife, or needle, of very delicate edge, is introduced obliquely beneath the integument, at a little distance from the part to be divided by a turn of the knife, when passed to the necessary extent, division is, as it were, stealthily effected ; the instrument is then withdrawn, if possible, still more cautiously than it was entered ; the aperture is instantly closed, and retained in apposition by suitable dressing. Thus the air is effectually excluded, and the object in view attained.

Tetanus.

This is a disease of the true spinal system ; the cerebrum being unaffected until a very advanced period of the case, when delirium or stupor supervenes, shortly before death, as in many other affections primarily unconnected with the nervous centres. The characteristic symptom is, true spasm and rigidity of the voluntary muscles. And, according to the extent and predominance of the muscles affected, various terms are applied. When the muscles of the neck and face alone are involved, locking of the jaw is the most prominent symptom—whence the vernacular term of Lock-jaw; and this form is called *Trismus*. When the muscles of the front are chiefly affected, bending the body forwards, it is said to be a case of *Emprosthotonos*. While *Opisthotonos*, of much more frequent occurrence, denotes the opposite condition ; predominant affection of the posterior muscles bending the body backwards, like a bow, until, in extreme cases, the resting points are the heels and occiput. Bending to either side is termed *Pleurothotonos*. And the strict acceptance of the term *Tetanus*, denotes involvement of all classes of muscles, without preponderance of action in any ; whereby the body is rendered rigid and straight.

Whatever form occurs, according to the above terms, may be either *acute* or *chronic* ; the former a most formidable disease, seldom admitting of cure, tending to involve the whole frame, and unfortunately the more frequent in occurrence ; the latter, milder in all its phases, more inclined to be partial, and much more amenable to treatment. The disease is also said to be either *Traumatic* or *Idiopathic* ; the former following wound, or other injury, and usually acute ; the latter of spon-

taneous origin, without any external and assignable cause, and usually chronic.

The most frequent form is that which is traumatic and acute; and the symptoms and character of this, may be taken as typical of the disease in general. It is more frequent in hot climates than in temperate; in military than in civil practice; in children and the middle-aged, than in youth and the far advanced in years; in men than in women. The existence of a wound is not essential; it has followed on simple fracture, and on a blow or bruise, even apparently slight. Wounds, however, are the ordinary exciting cause; especially those of a punctured and lacerated kind, inflicted in dense textures well supplied with nerves—as the fingers and hand. There is good reason to believe, that injury done to some individual nervous branch is prominently connected with the accession of the symptoms; that it has been punctured or torn, or partially divided, or included in a ligature applied to a bleeding artery; or that it is continually excited and injured, by some rough or sharp foreign matter lodged in the wound.

The predisposing causes of tetanus are not easily ascertained. But it seems quite certain that intestinal and uterine irritation, especially the former, act in this way; as also exposure to atmospheric vicissitude. And these, again—which, with wound, rank as predisposing cause—may, without any breach of surface, become the exciting cause of the idiopathic form of the disease.

The period of accession varies. In some cases, the symptoms appear within a few hours after infliction of the injury; in others, a few days elapse, and the accession is while symptoms of acute inflammation are present in the wound. More frequently, cicatrization is nearly complete; and, in such cases, it has been supposed that the exciting cause is a neuromatous formation in the injured nerve, which has become entangled in the dense cicatrix, and is thereby irritated. Certainly, such a morbid condition has been found in tetanic cases, more especially when following burns. When three weeks have elapsed, without any threatening of accession, the patient may usually be considered safe. Whereas, in hydrophobia, it will be remembered, the invasion is seldom till even a more distant period. “The disease is evidently dependent on a state of undue excitability of the whole spinal system; and this may be produced by different causes. That which is termed the idiopathic form has its origin in the centres; it may result in man from the operation of various predisposing and exciting causes; and may be artificially induced in animals, by the administration of strychnia. In the traumatic form, the morbid state has its origin in a local injury; and the irritation propagated from this, and operating through the spinal cord, may be itself a cause of many of the convulsive movements. But when the irritable state is once established in the nervous centres, convulsive action of the muscles may be excited by any stimuli, and even almost entirely without external causes. Hence it is, that while amputation of the injured part is not unfrequently(?) the means of saving the patient, if performed sufficiently early, it is attended with no benefit if delayed.”*

* Carpenter, p. 233.

The nerves concerned in deglutition are generally the first involved by the spinal irritation; and the obedient action of the muscles produces distortion of the mouth, with pain and stiffness in the neck and jaws—usually the first symptom. If the orbicularis oris predominate in action, the mouth assumes a puckered appearance; more frequently the antagonist muscles are in the ascendant, causing a ghastly smile. A dryness and soreness of the mouth are felt; swallowing and mastication are difficult; the neck becomes stiff, and the rigidity increases; and attempts to swallow are apt to induce convulsive efforts, perhaps threatening suffocation. Ultimately, the jaw becomes rigidly closed; the masseters and temporals feeling hard and bulging. All the muscles of the face are involved. The forehead is much wrinkled, both longitudinally and transversely; and, the eyebrows, by the action of each corrugator supercilii, are closely approximated, forming a sharp angular curve at their inner and highest part. The eyes, usually, are not fully opened; the orbicularis and levator, seeming almost to neutralize each other. The eyeballs are distorted, and fixed. The nostrils are dilated. The angles of the mouth are drawn much backwards, and, the elevators predominating over the depressors, are somewhat elevated. The orbicularis oris binds the lips firmly on the teeth; which, however, are always more or less seen, and sometimes wholly disclosed. The expression is indicative of much suffering, and quite peculiar to the disease; and may indeed be said to be pathognomonic. The marked change of countenance has not been long assumed, when a distressing pain occurs at the lower part of the sternum, shooting backwards in the direction of the diaphragm; accompanied by spasms of that muscle, impeding and disturbing respiration. This is the first of the involuntary muscles which is affected. They now, however, become more and more involved. The spasms are more intense; sometimes remitting, even to a considerable extent, but never undergoing complete intermission. Exacerbation is induced by the slightest external cause. In general, the whole body becomes fixed and rigid; and occasionally distracted by convulsive movements. The abdominal muscles are especially affected; the recti have been torn by the violence of contraction. The arms usually are the last disordered; and the fingers sometimes continue mobile to the last. The tongue, too, remains long free; when affected, it tends to protrude, is bitten by the teeth, and bloody saliva trickles from the grinning mouth, fearfully aggravating the already horrible expression of countenance. The sphincters are usually contracted. The bowels are obstinately constipated; partly from this cause; but mainly from inherent derangement of the functions of the whole alimentary system; and, when movement is obtained, matters much changed from the normal state, and of remarkable fœtor, are passed in great abundance, showing great derangement of the intestinal canal to be a marked and invariable concomitant of the disease. And, as already stated, this derangement may also, with much probability, be considered as connected with its origin. There is difficulty in passing water, on account of spasm of the muscular fibres at the neck of the bladder, and in the perineum; occasionally, there is marked relaxation of these, during which the detrusor may squirt forth the

urine with much force. Intense pain accompanies the spasmodic exacerbations; and there is generally a profuse perspiration from the whole surface, said to have a peculiar and pungent odour. The pulse at first may be both strong and full; but it soon falls from the sthenic type, becoming weak, and indistinct. No delirium, or other apparent disorder of the cerebral function, occurs, until shortly before death. As in hydrophobia, the patient perishes either by asphyxia, during a spasmodic paroxysm; or of exhaustion, during a period of remission; most frequently in the latter mode. It is also possible that death may occur suddenly, from the muscular fibres of the heart having become involved in spastic rigidity. The duration of the disease is seldom beyond a few days, in the acute form. The chronic may continue for more than a fortnight; but then there is usually recovery.

The morbid appearances found after death are similar to those in hydrophobia; and, likewise, are far from uniform in their nature. The brain seldom shows aught amiss; unless it be an unusual amount of serum. The spinal cord usually evinces manifest congestion, both in itself and in its membranes; more especially at the origins of the nerves; and the amount of serum is preternaturally and considerably increased. The lungs are congested: there is unusual vascularity of the air passages, and of the pharynx, œsophagus, and stomach; and sometimes these canals retain a diminished calibre, the spasmodic contraction having not yet ceased in death. The nerves at, and leading from, the injured part, usually show increased vascularity, enlargement, and other signs of the inflammatory process, either chronic or acute.

In the traumatic form, it is in the nerves of the part that inflammatory change is to be looked for, not in the spinal cord; for, the disease is to be regarded as an extreme example of *irritation*, in the whole true spinal system, induced by inflammatory products in some portion of its periphery. The centre, no doubt, suffers by some vascular change also; but this is secondary, and in all probability seldom if ever amounts to true inflammation.

Myelitis—the inflammatory process in the spinal cord—induces symptoms of a tetanic character. The case is one of an inflammatory character throughout; and change of structure, more or less marked, is found in the medullary substance. But this is altogether different from true tetanus.

Treatment.—Prevention is most likely to be accomplished:—in the first place, by avoiding the class of wounds most prone to prove prejudicial in this way; in the second place, and mainly, by adopting the simple, non-irritating treatment of all wounds, such as we have endeavoured to inculcate. The disease having occurred, the indications of treatment resolve themselves into those which regard the part, and those which regard the system.

As to the part. Amputation has been proposed and practised, but with indifferent success. It can be of use only at an early period of the case, as already observed. Incision, made to surround the part on its cardiac aspect, deep and wide enough to cut off all nervous communication, is plausible in theory, and experience already has spoken somewhat in its favour. It is a simple and safe procedure, and may

often be practised when amputation cannot. For, the latter operation, at an advanced period, is by no means warrantable; the shock and loss of blood being certain to accelerate the fatal issue. The actual cautery is by some recommended for the wounded part, but upon what rational grounds it is not very easy to discover. On the contrary, the treatment there should be of the bland and soothing kind; as water-dressing, or light poultice—hot, and medicated by sedatives, as opium or belladonna; incision, however, being never withheld, to relieve tension, evacuate abscess, or arrest diffuse infiltration.

As to the system. Bleeding, in genuine tetanus, is not expedient to any great extent. If used at all, it must be early, and with a sparing hand; and, as in hydrophobia, rather as an adjuvant to other remedies, than itself a means of cure. Purging is essential, as can readily be understood; there is much filth to be dislodged from the interior, and much depravity of the intestinal secretion to be corrected. Croton oil, elaterium, or calomel, occupying little bulk, may be got over without much difficulty; and are to be continued, till the bowels respond freely to their use. Their operation will be well assisted, by terebinthinate injections per anum. Then, the attention is naturally directed to the most powerful of the sedative remedies. Opium has been given in large quantity; but proves comparatively inert; lodging, little altered, in the stomach—the function of digestion being probably much in abeyance. Lately, it has been proposed to administer it in the form of fume, à la Chinois; an expedient, not irrational, and worthy of trial. The *cannabis indica* has, in warm climates, greatly alleviated the symptoms; and, in some cases, seems to have contributed powerfully towards cure. In this country, its success has hitherto been not so great; and yet such as fully to warrant further trial. It is given in doses of three grains, repeated every half hour. Tobacco is a most powerful sedative, and is administered in the form of enema; a drachm to the pound of water, and the half given at a time; repetition being made according as circumstances may demand. Let it never be forgotten, however, that this remedy may readily become a poison; and that large doses, or reckless repetition of even small quantities, may wholly prostrate the powers of life, and carry off the patient. Each dose must be cautiously given, and its effects carefully watched; and while, with the tobacco, we endeavour to allay the nervous excitement and muscular spasm, with nutriment and stimuli we sustain the powers of life; finding this combination of a sedative with stimulus, not only expedient but essential. The warm bath has a relaxing effect on the muscular system; and this is much enhanced by medication of the water with antimony; from two to six drachms of the tartrate of antimony being dissolved in the ordinary bath. The remedy, however, requires care, like the tobacco, lest it prove excessive. Counter-irritation over the spine, with the endermoid use of sedatives, is advisable. Morphia may be sprinkled on the raw surface, or aconitine, or belladonna. For the same reasons as stated in the case of hydrophobia, probably the aconite may be the more hopeful of the three. Also, the application of cold by ice may be made trial of; stimuli, and support of the general system, being at the same time given, as in the case of the tobacco.

Throughout the whole period of attempted cure, the utmost quiet and seclusion should be observed; all noise, light, and prying visitors being excluded. Nourishment should be given, to as full an extent as circumstances place in our power; by the mouth, if possible; by the rectum; and by the skin. By nutritive enemata and baths, life may be prolonged for some considerable time after the power of swallowing has gone; and—as bearing upon this point—it is to be remembered that the greater number of patients usually die of exhaustion.

Mercury, pushed to ptyalism, has effected cures in hot climates; in this country it has proved less successful. Lately, the subnitrate of mercury, in doses of ten grains, has been strongly recommended; its effects are purgative, emetic, and diaphoretic; and the spasms are said to relax greatly, when these results have been obtained.

The wourali poison is esteemed the most direct, powerful, and simple of sedatives; an animal poisoned by it “sinks from existence in the most placid swoon.” The nervous system is chiefly acted on; and, after apparent death, from cessation of nervous function, the heart’s action may be continued for some time. When no large quantity of the poison has been administered, artificial respiration—maintaining the heart’s action—will sustain life, until the poisoning influence has passed away, and the nervous system has rallied from its temporary paralysis. It has been supposed, naturally enough, that such complete rest, ever though of short duration, afforded to the previously racked spinal system, might be followed by the best curative effect; that, on resumption of the nervous function, the tetanic symptoms would be found to remain partly or even altogether in abeyance; that either an immediate exemption from the symptoms, or palliation and a partial approach to cure, might thus be obtained. And experiments on the lower animals have, to a certain extent, shown that such expectation is not altogether unfounded. At one time, I held high hopes on this point; but I must confess that lately these have been very much beaten down; having been informed that, in some experiments on tetanic horses, the animal, whose muscles had been in perfect repose during the apparent death, for many hours, speedily became rigid as before, so soon as the nervous function was restored; and that the subsequent progress of the disease seemed to be in no degree alleviated. Yet, further experience on the brute creation is much to be desired in this matter; and not without hope. The proposed mode of application to the human subject is, to insert a small quantity of the poison into a puncture of the hand or arm; regulating its introduction into the system, and its effects there, by tightening or relaxing a ligature on the cardiac aspect of the wound.

In chronic tetanus, the principal remedies are purgatives, continued until a satisfactory result has been obtained upon the intestinal canal; support, by nourishment; and the more gentle of the antispasmodics. The heroic remedies are neither necessary nor expedient; recovery being as common in this, as it is rare in the acute form. After the tetanic symptoms have subsided, tonics are necessary, along with support, to remove the state of debility which tends to remain.

The means of diagnosis between tetanus and hydrophobia have been already noticed. Hysteria sometimes achieves a very close simulation;

yet capable of being readily distinguished by the careful observer, from the spasm and rigidity being more decidedly paroxysmal, possessing periods of complete intermission, and evidently being to a great extent within control of the patient's will; also by the ordinary signs of hysteria being present, usually in a distinct and prominent form.

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CHAPTER XVII.

OF BURNS AND SCALDS.

BURNS and scalds denote injury done by excessive heat; applied, in the former, by radiation, by flame, or by solids; in the latter, by heated fluids or vapour. Those inflicted by flame, heated oil, and steam, are the most severe; the temperature, and intensity of combustion, being great.

The dangers of this form of injury are various; even to a greater extent than wounds, they are not mere casualties happened to a part. 1. There is a shock imparted to the system, when the burning is extensive and severe, or seated in an important part; and under this shock the patient may perish, by syncope. 2. Imperfect or nervous re-action may result, to an excessive and uncontrollable degree; the patient sinking exhausted under febrile tumult of the asthenic kind, at a very early period. 3. Or, the re-action is of the sthenic type, and proves excessive; under the violence of the inflammatory fever, life may be endangered. 4. During the progress of the inflammatory fever, the internal organs, more especially the lungs, are apt to suffer; seriously complicating the case. 5. More remotely, the tedious cicatrization, the confinement, and the discharge, are prone to peril the system by hectic.

The classification, at once the most natural and most useful, is according to the extent to which the textures have sustained injury. I. The mere surface is involved, by a slight and temporary application of heat, usually in the liquid form. A mere erythema results, usually terminating in resolution; but not without risk, when occurring in the scalp, or when including a large range of any part of the surface. II. The cutis undergoes the inflammatory process, of a higher grade. Pain, swelling, and tension, are followed by vesication; and the vesicles may either suppurate, or disappear by desiccation. The heat may have been applied either in the fluid, or in the solid form. In the latter case, it is not uncommon for the cuticle to adhere to the heated substance; then no vesication forms, but, instead, a raw surface is left, of exceeding tenderness, which speedily inflames and suppurates, and probably is extended by acute and painful ulceration. This circum-

stance, occurring accidentally, well illustrates the importance of retaining the cuticle unremoved, and as little disturbed as possible, in those cases which are under treatment with vesications already formed. III. By a greater application of heat, in the solid form, or by flame, the external part of the cutis is cauterized ; killed immediately, or almost so ; and converted into an insensible slough, of a darker or lighter colour according to the rapidity with which it has been made to part with its vitality. Though the surface be insensible when lightly touched, yet acute pain is elicited by pressure. If the part have died instantly, there is no change in its character ; it is at once an eschar, and remains so, until detached. But when its death has been subsequent to the injury, and a gradual although still a rapid process, dark vesications may form, as in ordinary gangrene. After separation of the slough, the pain, which had almost ceased shortly after the infliction of the injury, is renewed, of a very intense character ; in consequence of the sensitive cutis, which has been but half destroyed, now constituting the raw and inflaming surface. This, in truth, is the most painful of all burns ; and, as formerly observed, ought to be avoided, when such injuries are inflicted by design, with a curative object in view. By gun-powder, this class of burn is often produced ; in such cases, the surrounding skin is begrimed by lodgement of the grains. IV. The skin is wholly cauterized ; at once converted into the state of eschar, dark coloured, dry, and insensible. The dead portion contracts, in its change ; and, consequently, the surrounding integument presents a puckered appearance, so long as the eschar remains adherent. Pain is acute during the burning, but soon subsides ; and, for a time, is almost entirely absent. On the inflammatory accession, necessary for detachment of the eschar, pain returns ; but never is of the inordinate degree which invariably attends the like stage in the preceding class of injury. This is the form which it should be our object to produce, in the use of the actual cautery. V. The cauterization extends deeply ; producing a sonorous, black, brittle, and depressed eschar, more or less extensive ; slow in separating, and followed by much suppuration ; forming a wound very tedious in its progress towards cure. And the cicatrix is usually of an unsatisfactory kind, when obtained. VI. The entire thickness of a limb is reduced to the state of eschar ; and removal by amputation is demanded. The spontaneous separation is slow, a bad stump is formed, and the system is under much danger by the protracted hectic.

In general, these various classes are more or less blended. For example, in the centre of a burnt part, where the heat has been most intensely applied, there may be the depressed eschar ; exterior to that, the skin only in part destroyed ; beyond this, the skin, alive, and about to be acutely inflamed ; and, exterior to all, such an amount of injury as will produce but an erythema. The most severe examples of the injury are usually those caused by flame, as when the clothes have taken fire ; for, the part itself is made to contribute towards the combustion ; and this is intense and rapid.

As regards prognosis, it is important to remember, that the loss of substance often proves more extensive, than it at first seemed. A part dies immediately ; but another, and sometimes a larger, portion perishes

subsequently, under the inflammatory action ; the heat was insufficient for the immediate extinction of its vitality, yet lowered this so far as to render it unable to withstand even the ordinary vascular action which invariably ensues. And, thus, the immediate eschar may come to appear insignificant, in comparison with the subsequent slough. In cases suspected to be severe, it is always a favourable sign to find vesications form ; denoting that the part still retains at least a certain amount of vitality. Prognosis is further dependent, not only on the extent of injury, but on the previous state of the patient's system, and on the nature of the part whereto the injury has occurred. Burns are most dangerous on the head, neck, and trunk ; and especially when affecting the genital organs, at a tender age.

The constitutional symptoms have been already noticed. There is first the shock or state of depression ; from which re-action takes place, of either a sthenic or an asthenic kind ; usually the former, unless the accident be very severe, or the system previously much enfeebled. Then comes inflammatory fever, more or less violent, accompanying the inflammatory process which necessarily ensues in the part. About this time, the constitutional symptoms are apt to become unpleasantly complicated, by evidences of acute affection of the internal organs ; the lungs are most apt to suffer, by inflammatory affection of the bronchial membrane. Effusion may occur in the pleural cavity ; the mucous lining of the intestines, more especially of the duodenum, is apt to ulcerate ; and the brain may become the seat of serous effusion. The inflammatory stage having passed, the symptoms abate—if the sore left be slight, and the progress towards cure satisfactory. Otherwise, hectic sets in ; and, in the more extensive and protracted cases, this in its turn may give way to confirmed collapse. The extremes of age—childhood and senility—are more liable to suffer untowardly, than the adolescents and adults, as can readily be understood.

The process of cure is uniformly tedious. A portion usually dies ; either immediately, or subsequently under the vascular action. This must be detached ; and inflammation, bringing ulceration, accordingly supervenes. On subsidence of these, reparation is begun, at first energetically enough ; but the effort soon flags, and the progress is slow and uncertain. The injury has effectually impaired the vital power of those parts on which the burden of the reproductive effort is thrown ; and they are not equal to its efficient sustentation. Besides, there is much loss of substance ; the production of new matter to fill the gap, as has just been stated, soon comes to be scanty ; the healing result is, in consequence, mainly to be effected by contraction of the surrounding original textures ; and, whenever there is much to do in this way, a long time is always required to do it. But, besides that contraction and cicatrization of the sore produced by burn is always tedious, from this cause, there is also a proneness to produce deformity. For, by the contraction of the original textures, much displacement in the relations of the neighbouring parts is likely to ensue ; all the more, in consequence of such contraction not ceasing, on cicatrization being completed, but continuing for some time afterwards. So much have the reproducing parts had their powers weakened, that they not only form

little new substance, and leave the greater part of the closure to contraction of the original textures; but, the little new which is produced is but imperfectly organized; and, consequently, like all similar adventitious structures, it is prone to disappear, or at least to diminish, by absorption. The peculiarities in the healing of burns, then, may be shortly stated to be; that they heal slowly, and much more by contraction of the old structures than by the formation of new; the new matter is imperfectly organized, and liable to absorption; and, consequently, contraction continues, for some considerable time after completion of the cicatrix.

Treatment.—No class of injuries has been more the subject of empirical treatment than burns, even in the profession. And yet the indications can be laid down, as plainly as in any other affection. 1. Assuage locally. The smarting pain of even a slight burn is not easily borne, and the sufferer seeks anxiously for relief. If he be seen immediately after the infliction, there is nothing better than instant immersion of the part in cold water, where it is to be retained, not for minutes, but for hours; the temperature being kept continuously low, by additions, as circumstances may require. A doubly beneficial result is obtained. The heat and pain are mitigated, and, at the same time, the inflammatory process is held in abeyance; in the slighter cases, it may never occur; in the more severe, its attack will be less violent than it otherwise would have been. Afterwards, it is our principal object to prevent the contact of atmospheric air; the stimulus of which would certainly induce, or aggravate, inflammatory action. In the slighter cases—those of the first class, and a few of the second—we hope to avert true inflammation altogether, and to obtain cure by resolution, with or without vesication, and certainly without the formation of ulcer or secretion of pus. After discontinuance of the cold, therefore, the part must be protected in some way from without. It may be enveloped carefully in a rather thick roll of cotton wadding, which is retained by gentle deligation. Or it may be coated by a layer of some bland adhesive substance, which will not irritate the raw or injured surface, and yet will effectually exclude the air; as soap, gum, or varnish. The gum is probably the preferable, as recommended for unclosed wounds; it is certainly bland; with ordinary attention can be kept perfectly protective; and has the advantage of permitting the condition of the part to be observed, almost as well as if it were wholly uncovered. Or the part may be dusted over with flour; but, when vesication is expected, this is an objectionable form of protection; in as much as the serum bakes it into crusts, which crack, loosen, and are apt to irritate injuriously. Vesicles, when large, are punctured, to permit free escape of their contents, so relieving tension; but especial care is taken not to ruffle or displace the cuticle, which is certainly the best protector of the tender surface beneath. 2. Calm and restore generally. The state of depression must be watched in the first instance, and nothing done to favour its continuance. On this account, when a burn or scald involves a large part of the surface, the continuous use of cold cannot with propriety be had recourse to. Under such circumstances, a warm solution of opium, or other anodyne, is preferable. When the duration and de-

gree of shock threaten to prove excessive, restoratives must be employed, as heat to the general surface, and warm drinks internally; followed, if need be, by wine, ammonia, or other stimulants. If re-action prove premature and asthenic, it must be moderated by opium or other calmatives. 3. Keep antiphlogistics in view. When stimulating to overcome the shock, the coming sthenic re-action must always be remembered. And, while we prevent sinking, we are to be careful not to expedite and aggravate the impending inflammatory action. 4. Promote the separation of the sloughs. For this, poultice, or warm-water dressing, are the suitable applications. A certain amount of inflammation is essential for detachment, and under these epithemes it advances favourably. For the severer burns, the cotton, gum, soap, and varnish are manifestly unsuitable; the first, especially, would speedily become soaked with the discharge, and either require frequent renewal, or else prove a very hot-bed of pestilential putrescence. It may happen, occasionally, that the central portion of the eschar is detached at an earlier period than the margins; and pus, accumulating there, does harm to the inflaming and ulcerating textures beneath. Under such circumstances, the elevated and tense dead portion—the least pressure on which produces much pain—is to be freely cut through by the bistoury. 5. Limit the inflammation. A certain amount of this is necessary, to separate the dead and dying parts from the living, and to originate the subsequent action of granulation. But we desire no more than what is essential. The part is kept at rest, in a suitable posture, and is fomented and poulticed, or enveloped in the water-dressing. The antiphlogistic regimen is enjoined, in moderation. The bowels are kept open, and perhaps antimony is mildly exhibited. In the more urgent cases, a moderate bleeding may be taken from the arm. But all this must be done with caution, sparingly and grudgingly; for we know full well that every available resource of the system will by and bye be called upon, during the protracted period of granulation and probable hectic. 6. Promote granulation. So soon as the inflammatory action has subsided the water-dressing is applied, not hot, but tepid, as a mere detergent and protective; and this is continued, so long as the granulating surface remains of a healthy and vigorous character. This period is but a short one, however; the sore soon assumes the weak character, requiring medication of the dressings by various stimulants, as the salts of zinc, copper, iron, silver, &c. At the same time, early support by bandaging is usually expedient. By some, a weak solution of the chloride of soda is held in much repute, as an application from the first; but this seems to be its proper place; and, in this place, I can testify from experience to its efficacy. 7. Moderate contraction. And remember that the centripetal movement of the old textures does not cease on cicatrization. The parts implicated in the injury, mediately and immediately, must be placed in their proper relative position, and be retained so, by suitable retentive means, during the whole period of cure. For example, in burns of the neck with loss of substance, the head must be placed and kept erect by bandaging; otherwise the chin will be drawn down upon the sternum; and frightful deformity ensue, by traction of the fascial integument. In less extensive injuries,

on the face, arms, or other exposed parts, strips of adhesive plaster may be so arranged as to moderate the centripetal movement. This opposition, however, must never be carried so far as to peril the frame, by hectic from tedious cure. When orifices of canals are implicated—as the nares, urethra, rectum—they are to be kept distended by plugs or bougies, until the period of contraction has gone by; in order that the normal calibre may be retained. When opposing surfaces are implicated, as in extensive burn or scald of the fingers, anormal union is to be prevented by the daily and careful interposition of dressing; and it is well, at the same time, to maintain a considerable pressure at the points of commissure. 8. Retain the functions of joints. This is effected by passive and frequent motion. But sometimes, the parts exterior to a joint are so wholly involved by the injury, as to render it obviously impossible to fulfil this indication. The joint must become stiff, by a kind of spurious ankylosis. And we have in these cases to content ourselves with securing such a position of the rigidifying part, as shall afterwards prove most serviceable; the elbow, bent at right angles; the knee almost straight. 9. Maintain the powers of the system. This is done by attention to air, exercise, and clothing; by generous diet; and by the use of tonics and stimuli—of the latter, the cantharides is often a most efficient form. A view towards this indication must always pervade our fulfilment of the fifth. 10. Remedy deformity. In spite of all efforts to moderate contraction, and maintain due relation of position, deformity is of frequent occurrence, when much loss of substance has been sustained. A simple incision may sometimes suffice, when the treatment has been negligent. Mere division of the tight cicatrix may permit the parts to be normally re-adjusted; and then, the proper retentive means being employed, a better healing may be obtained. But perhaps there has been no faulty treatment; every thing has been done to prevent displacement, and yet it has occurred. Or, it may be that, to save the system and obtain a cure, the moderating means have been less energetically employed towards the close, than at the first. In short, there has been much loss of substance; and the part could not have healed at all, without very considerable contraction of the old textures. In such cases, the deficiency must be supplied. By incision, the cicatrix is divided; the parts are re-placed in their proper position; and then a portion of integument and subcutaneous tissues, of suitable dimensions to occupy the gap, having been detached by incision from the vicinity, is adjusted in its new place, and there retained by sutures and plasters; a connecting slip being left undivided, whereby its vitality is maintained. It adheres, and effectually prevents re-contraction; the parts retain their normal position, and the deformity is removed. The wound, whence the atoning flap was taken, is brought together, and treated for either adhesion or granulation, according to its form and circumstances. Sometimes, the new matter of the cicatrix is unduly prominent. It may be brought to its proper level by pressure carefully applied; for, as already observed, such adventitious structure is very amenable to absorption. Should pressure fail, the dense prominence may be excised, and the wound treated on the ordinary principles. 11. Amputate in certain cases. When a limb is

charred throughout its entire thickness, amputation is expedient at once ; so soon as the shock of the injury has sufficiently passed away, to admit of the operation being safely borne. When a joint has been opened into, or a bone necrosed ; or when from any other cause suppuration is profuse, healing slow, and hectic urgent—the part must be sacrificed to save life ; and then the amputation is secondary. 12. Throughout the whole cure, have great regard to the state of the internal organs, especially the lungs ; and chiefly during the inflammatory stage. Also, let it be remembered, that, in the case of extensive burns, the patient never can be reckoned safe until after the whole has been fairly cicatrized. The system may have power enough, by a struggle, to effect the skinning over ; and may then sink, as if exhausted in the effort.

Such are the principles of ordinary surgery, which are to guide us in the treatment of this form of injury. Some strenuously advise stimulating applications from the beginning ; and a theory has been made to suit the practice. Neither seem to merit approval. Alcoholic applications may sometimes prove serviceable, on a scalded but unbroken skin, by the cold which their evaporation produces. And, in the severer injuries, any stimulant, at first increasing the pain, may afterwards be truly said to deaden it ; by accelerating and aggravating the inflammatory action, so as speedily to overcome the impaired vitality, and convert all into one slough. But such is not wise and prudent surgery. Let stimulants, both internally and externally, be retained for their proper time and place ; and these will be found in the second, sixth, and ninth indications of cure.

*See Report on the treatment of Burns & Scalds
in Practical Medicine vol. 1853, p. 254. The principle
stated is, to use Cotton Wool & opiate.*

CHAPTER XVIII.

EFFECTS OF COLD.

THE effects of intense cold applied to a part, so as greatly to diminish vital power, and not unfrequently to produce local death, more especially when heat or other stimulus is rashly used—constituting what is termed *Frost-bite*—have been already considered.

The term *Chilblain* is applied to a less evil; the effects of cold, as affecting chiefly the surface. The parts most liable so to suffer, are those which not only are habitually exposed to cold, but likewise are naturally of comparatively weak circulation, and consequently of low power; as the fingers and hands; the toes, feet, heels, and ankles; the tips of the nose and ear. And these are most especially liable, when the individual is naturally the subject of imperfect extreme circulation; from dyspepsia, or other disease, or from original conformation. Like the frost-bite, chilblain is usually the secondary effect of cold; caused by premature restoration of heat and circulation; and the result, usually, of repeated exposure and alternations of temperature. Re-action is excessive, with diminished power of control. Yet a high degree of over action does not ensue; otherwise gangrene would inevitably result, and the case be termed one of frost-bite. Either a congestion, or a chronic inflammatory process is established. An unpleasant sensation of heat is complained of, often attended or followed by an intolerable itching. The part swells, and becomes of a dark red hue. No farther progress may be made, the part remaining in this congested state for a long period; not advancing to higher vascular results, and but little disposed to recede. But, very frequently, vesicles form; and these do not dry and desquamate in the ordinary manner; but, having given way, disclose a very painful ulcer beneath, emitting a thin watery discharge, slow to heal, and prone to assume either the irritable or indolent characters; often, at first irritable, and secondarily indolent. Or, instead of vesication, the surface seems to crack; and the fissures degenerate into ulcers of a similar kind. Usually, the ulceration is but superficial; occasionally, however, it extends deeply, involving tendons, and even more hidden parts. In some cases, the vitality is wholly overborne, and gangrene supervenes.

Prevention is better than cure. By avoiding exposure to extreme cold, more especially in the parts most liable to suffer. And, when exposure has been incurred, taking care that re-action is gradual and safe; using, for this purpose, the means recommended in the case of threatened frost-bite.

When the congestive state has been induced, the best remedy is the nitrate of silver, applied so as to blacken the integument; carefully

avoiding vesication. For the ulcer and fissures, at their early and irritable period, nitrate of silver in substance is suitable, followed by light poultice or water-dressing. When they have become weak or indolent, as they tend soon to do, the various stimulant applications are required, along with uniform support by careful bandaging. A bandage carelessly applied, so as to cause partial constriction, would certainly be productive of very serious injury to a part whose vital power remains so long and so much impaired. Occasionally, amputation of a finger or toe may be demanded; ulceration having extended deeply, or gangrene having supervened.

When the whole frame is exposed to intense cold, the general powers of life gradually cease. The patient grows feeble and languid, inclines greatly to sleep, sleeps, becomes comatose, and dies. On dissection, passive congestion is found in all the internal organs, but especially within the cranium, where the amount of serous effusion is also considerable. To prevent the extreme sedative result, the mind must be made to work against the body. Sleep and decubitus must be resisted, wakefulness and bodily exertion compelled. To restore, the same gradual appliances must be used as in regard to a part; cold friction; gradual increase of the temperature; and very sparing administration of food, drink, and other stimulants, internally; otherwise, what may be termed universal gangrene, by over-action affecting the whole frame, will certainly ensue.

CHAPTER XIX.

OF FRACTURE.

FRACTURE, or solution of continuity in bone, is usually the result of external violence; sometimes it is effected by muscular action alone. And this, too, is not a mere local casualty; but apt to be followed by inflammation, suppuration, gangrene, erysipelas—bringing life into the greatest danger.

Various terms are employed, to designate the kind and circumstances of the injury. It is called transverse, oblique, or longitudinal, according to the direction in which the break has occurred. It is said to be *Simple*, when there is mere fracture of the bone, at one part; and nothing more. *Compound*, when in addition to the injury of the bone, there is an open wound of the super-imposed soft parts, communicating with the fracture. *Comminuted*, when the breaking is not at one point but at many, occasioning numerous fragments. It is said to be a case of *Fracture with wound*, when the co-existent wound of the soft parts

is at a different part, and does not communicate with the injury of the bone.

The parts of the skeleton most liable to fracture are the long bones, more especially of the extremities; and these may suffer by violence applied either directly or indirectly. The flat bones, with the exception of those of the cranium, are less liable, and seldom give way except under violence both direct and severe.

The bone does not always break at the point struck; a blow on the symphysis menti often occasions fracture of the jaw, near the angle; a concussion applied to the bones of the leg, through the foot, ordinarily produces fracture of the tibia, near the ankle, and of the fibula, at its upper part.

The broken fragments usually become more or less displaced. The force, wherewith the injury was inflicted, may push one or both aside; and the weight of the limb may increase the displacement, when the part is raised, or when an attempt is made to use it. But the paramount displacing agent is the action of those muscles which are implicated in the injury. Sometimes, there is retraction of the fragments, and elongation of the part, as in transverse fracture of the patella. Most frequently, there is crossing and overlapping of the fragments, with consequent shortening of the limb. Sometimes, one fragment alone is displaced; as in fracture of the clavicle; the sternal portion remaining in situ, while the lower passes downwards and forwards. In other cases, both suffer displacement; as in fracture of the humerus below the bicipital groove; the upper fragment passing in towards the chest; the lower being elevated, and displaced outwards, by the deltoid.

One fragment usually is on a higher level than the other, seeming as if it had risen above its fellow; and hence we frequently speak of "the rising end of the bone." But this phrase, if not rightly understood, may lead to great practical error. The sternal end of the fractured clavicle seems to rise, but in truth is in its place; while the lower fragment has fallen away. In attempting re-adjustment, we are not to repress the apparently "rising end;" but, leaving it alone, bring up to its level the one which is truly displaced. On the other hand, the "rising end" may be not more apparent than real; as in fracture of the tibia, just below its tubercle; and in fracture of the femur just below the trochanter minor. In each of these cases, the upper fragment is truly tilted forwards; and means for its reduction are undertaken with propriety.

By the displacement, the neighbouring parts are liable to be compressed, torn, or otherwise injured; and hence the most serious consequences may ensue; unless such displacement be detected, understood, and speedily rectified. For example, the displaced fragments of a broken rib may puncture and irritate the pleura and lungs, exciting violent inflammation there. And displaced portions of a broken cranium may cause a like injury to the brain and its membranes, followed by results still more disastrous.

The proneness to fracture varies with age. The bones of the old man are brittle, and give way under amounts of violence which would

have little disturbed them in younger years. The bones of the child, on the contrary, are fully as likely to bend as to break.

Bending of the long bones, with partial fracture, is by no means uncommon in the child and adolescent, from injury applied to their extremity. The bones of the fore-arm, for example, are not unfrequently found more or less curved, from a fall, saved on the hand. The continuity is plainly uninterrupted, the bending is apparent; there are much pain, deformity, and loss of power, but no crepitus; the bending can be undone, by force suitably applied; and then, for the first time, obscure crepitus can be perceived. A few of the osseous fibres had given way, on the convexity of the curve; and these, not being brought into apposition, could give no crepitus until the bending was undone. In other cases, the bending is unaccompanied with any solution of continuity. For example, a child may receive a smart blow on the head; a depression of the cranium may be so occasioned, without any fracture; and the depressed portion, by the innate and gradual resilience of the osseous tissue at that age, ultimately resumes its normal relative position.

Constitutional vice often predisposes to fracture. The cancerous diathesis does so, as we have already seen; and, still more so, that anormal condition of the skeleton denoted by the term "*fragilitas ossium*." It is a common saying that, in frost, the bones are more brittle than at other times; but, probably, the frequency of fractures then can be more rationally accounted for, by the increased liability to fall, and by the hardness of the ground on which the falling body is received. The functions of certain bones predispose to their fracture; the clavicle, supporting the shoulder, is rendered liable to fracture by blows or falls on that part; and the radius is similarly circumstanced, when compared with its companion the ulna, in consequence of its special connexion with the hand. Others, again, are rendered liable by the mere exposure of their position. The unprotected cranium, for example, is more liable to fracture, than the comparatively well-cushioned scapula; the clavicle more liable than the ribs; and any of these more liable than the spine.

While such circumstances may be said to be the predisposing causes of fracture, the exciting causes are two; external force and muscular action. The force may be applied directly, as by a blow, or by a heavy weight passing over the part. Or it may be indirect, as when the clavicle breaks from violence received on the shoulder, or the fibula, near its head, from a shock sustained on the foot. Again, disruption of a bone may be effected by muscular agency alone; as when the patella, or olecranon, is snapped across, during an intense and sudden muscular effort; or, when the radius gives way under attempted feats of strength, as is not uncommon.

The *symptoms* of fracture are usually sufficiently plain. There is obvious deformity of the part; and its muscular power is all but lost. A fractured arm, for example, is swoln, and out of drawing; and the patient is unable to move it, without the assistance of the corresponding member. Sometimes, as in the case of the patella, the part is elongated; much more frequently it is shortened; the lower extremity, in

fracture at the hip, may be abbreviated to the extent of two inches or more. Voluntary motion is very much abridged; in many cases, the patient, of himself, can move the injured limb little if at all. Involuntary motion, on the other hand, is very much extended; that is to say, the surgeon can, though not without inflicting much pain, move the limb in directions and to an extent of which it was previously incapable. And, at the site of fracture, the slightest examination usually makes it abundantly plain that the part is remarkably and preternaturally mobile. Pain is great and constant; and ever and anon liable to sudden exacerbation, from spasmodic twitchings of the muscles implicated in the injury, whereby the bones are displaced anew, and the soft parts irritated and torn. If either fragment come in contact with nervous trunks, compressing, puncturing, or in any way irritating these, the pain is likely to prove extreme. Swelling invariably occurs, and is of three kinds. 1. The displacement and overlapping of the fractured ends produce a greater or less enlargement of the part, immediately after infliction of the injury. And if muscles be relaxed by the displacement, the bulging into which they are consequently thrown, will contribute to the immediate swelling. 2. The first swelling is increased by extravasation of blood, which inevitably follows the solution of continuity in the bone, and the co-existent laceration of the soft parts. If any considerable vessel have been injured, this kind of swelling may prove very great, partly by blood accumulating around the fracture, partly by its being infiltrated into the surrounding tissues. 3. The second swelling, in its turn, is followed and modified by that which attends on vascular action; beginning to form after the lapse of a few hours. The tissues then become infiltrated, partly by serum, partly by fibrinous exudation.

But the peculiar and diagnostic sign of fracture, is what is termed *crepitus*; a sensation of rubbing, grating, and crackling, which is imparted to both hand and ear, when the fragments are moved one upon the other, with contact of their broken surfaces. When there is no great displacement, the fractured ends remaining partly in apposition, this crepitus may be felt on the slightest movement of the limb; and, often, both the patient and his attendant are made very plainly aware of its existence, by the involuntary movements which spasms of the muscles from time to time occasion. But, when the fracture is transverse, the displacement great, and the fragments completely overlapping, crepitus is not so easily found. Reduction must be effected, in the first instance, in order that the broken surfaces may be brought in contact with each other; and then, by movement, the desired sign will be plainly enough emitted. In fracture of the neck of the femur, for example, rotation of the limb will be quite unattended with crepitus, so long as the lower fragment is retracted, and lodged on the brim of the acetabulum, free from the head of the bone; but, so soon as, by gentle extension, the normal length of the limb has been restored, crepitus will be produced by but very slight movement.

Certain fractures, termed *Impacted*, rarely afford crepitus. One fragment is driven into and lodged in the cancellous texture of the other, by the same violence which caused the fracture; and so the bone

is scarcely broken, when it again becomes fixed, with its continuity apparently restored. There is little deformity, no unnatural mobility, and usually no distinct crepitus under ordinary manipulation. Examples of this form of injury are found, in fracture of the distal extremity of the radius, and at the trochanteric space of the femur.

The manipulations necessary to ascertain the nature of the accident, and which are especially directed towards detection of crepitus, are to be conducted with all gentleness, so as not to produce unnecessary pain, or endanger further injury to the soft parts, with aggravation of the subsequent vascular action; and yet with determination, sufficient for fully satisfying the examiner as to the diagnosis. It is much better that one thorough examination should be made at once, painful though it be, than that more gentle movements and inquiries should be made, with frequent repetition; delaying the means of cure. Also, let it be borne in mind, that at whatever cost of suffering to the patient, it is our paramount duty to make such a thorough examination, for two reasons; in the first place, in order that the required repose and treatment of the part may be immediately instituted; in the second place, and mainly, that error of diagnosis may be avoided. For, suppose that in injury of the hip, an insufficient examination has led to the latter event; that a fracture is believed to exist, while in truth the injury is dislocation. The ordinary treatment for fracture is applied, and continued for the usual period. On finally undoing the retentive apparatus, the true nature of the case may be for the first time disclosed; too late to remedy the evil. The patient remains a cripple for life; and an untoward event has happened to the surgeon's welfare and reputation.

The required examination may usually be conducted thus. The patient having been placed in a suitable posture, the distal extremity of the injured bone is taken hold of by the surgeon's right hand, while his left is placed over the seat of injury. With the right hand, the limb is gently extended, till the normal length is nearly or altogether restored; then, while extension is maintained, gentle rotation is made; and the fingers of the left hand are used coaptatingly, so as force the broken fragments—if such there be—to rub on each other, and emit the expected crepitus. At the same time, the fingers of the left hand, by another sign, become aware that solution of continuity exists in the shaft of the bone; the lower fragment being found to roll in obedience to the rotating movement of the manipulator, while the upper, just as plainly, is unaffected thereby.

It is obviously of much importance, that such examination should be made at as early a period as possible; before spastic rigidity of the implicated muscles has occurred, which might oppose the required extension and coaptation; and before concealment of the relative position of the parts has taken place, either by the blood of extravasation, or by the exudation of the excited vascular action.

The *prognosis* varies, 1. According to the age. In the young, the process of reparation is usually both more rapid and efficient, than in advanced years; also, the system is less liable to suffer by the accidents of the injury, and by the confinement which its treatment may

require. 2. According to the site of the injury. Fracture of a long bone, near its middle, is less important than a similar injury which implicates the articulating extremity. Fracture of a slight and superficial bone, as the clavicle, is less likely to prove troublesome than similar injury of one which is large and thickly covered, as the femur. Fracture of the neck of the femur, within the capsular ligament, is but little capable of satisfactory union; while a more severe amount of injury, immediately exterior, through the trochanters, unites readily. Fracture of the scapula is seldom troublesome, either at the time or subsequently; fractures of the cranium, pelvis, and spine, are invariably fraught with the utmost danger. 3. According to the nature of the fracture. The Compound is obviously more hazardous than the Simple solution of continuity; the Comminuted, and the fracture with wound, are more likely to prove troublesome than the fracture which is in all respects Simple. 4. According to the state of system. The patient in ordinary health is more likely to advance favourably in the cure, than one who is either debilitated by privation or disease, or plethoric and prone to undue excitement. Also, the patient affected by any constitutional vice, which favours the occurrence of fracture, is obviously situated unfavourably as to the cure. And again, it is often found that the pregnant female has a slower cure of fracture, than would otherwise happen; the nutritive powers of the system seeming to be almost wholly devoted to the exalted uterine function.

The mode of union, or reparative process, is a subject of much importance; on the right understanding of which the indications of treatment depend. It may be conveniently divided into the following stages, it being understood that the fragments have been duly re-adjusted, and are so retained. 1. Blood is extravasated at the site of fracture; and, accumulating, distends the surrounding parts into a kind of pouch, in which the fractured ends are laid; and the cavity of this pouch is occupied by the extravasated blood, partly fluid, partly coagulated. The surrounding parts are condensed; and, obeying the stimulus of the injury and displacement, become more energetic in their circulation—prepared for the unusual effort in nutrition which is about to be demanded of them. 2. The extravasated blood is absorbed; and the absorbents are also busy on the ends of the fractured bone, depriving them of their earthy matter to a great extent, and so preparing them also for higher efforts as a vascular tissue. Liquor sanguinis is effused from the parietes of the pouch, from the ends of the bones, and from the periosteum which invests them; and this plasma assumes the position which the blood occupied. The pouch, however, has somewhat contracted from its first dimensions, by tumescence of the parietes—favoured, or at least permitted, by the gradually decreasing extravasation. It has been a source of hot dispute, to determine from what tissue this plasma proceeds. Probably it is the offspring of every tissue implicated; effused by bone and by periosteum, and also by the textures constituting the parietes of the containing pouch, whether these be muscular, fibrous, fatty, or cellular. Perhaps, it may be held enough for the practical inquirer, that there is the plasma, come whence it may. The plasma having been exuded, consolidates; its serous portion is absorbed; the

fibrin remains, and becomes organized. And this organizing plasma not only occupies the pouch, but is also situate between the fractured ends of the bone, and in the interior. At the same time, a fibrinous exudation is taking place in the soft textures exterior to the pouch, whereby they are still further condensed and tumefied. A portion of this is imperfectly organized; and remains for a time—sometimes considerable. The rest is absorbed, previous to organization, on subsidence of the vascular action by which it was induced. That action is a part of the inflammatory process; but only a part. It never rises higher than active congestion, otherwise the process of repair were arrested and undone. 3. The period of plastic exudation may be said to have passed, after eight or ten days. Then the process of organization advances. The plasma becomes vascularized, and passes into the transition state of cartilage. 4. The organized and transitional mass contracts, by interstitial absorption; increases in density; and gradually passes into the condition of bone. At the same time, the surrounding parts, where immediately in contact with the ossifying mass, are more and more condensed; become continuous with the ruptured and engorged periosteum; and assume the general characters of that texture, as well as its function of investing and administering to bone. 5. Ossification advances, from the periphery. The most exterior part of the plasma is the first ossified; and thence the ossification gradually approaches the interior. In obedience to the general law, the first act in the process would seem to be that of the parent bone. Nodules of new osseous matter form on it, where in contact with the ruptured periosteum—the bare extremities themselves undergoing an opposite change as yet, parting with a large share of their original earthy matter, as already stated. These nodules would seem to constitute the nucleus or base of the new bony structure; and are found on each fragment, and on its every aspect. From these nuclei the ossification advances, and a case of bone forms on the exterior of the plasma; advancing from each fragment, and meeting near the centre of the space; the ossification begun by the original bone, continued and maintained by the soft parts—first by the original periosteum, and then by the ordinary texture which, by condensation and other change of structure, have come to assume not only the appearance but the function of the investing membrane of bone. Where the original periosteum is deficient, there is no corresponding hiatus in the new bone, as in the case of necrosis; for, the ordinary soft textures are not in a state of true inflammation, and all their exudation is euplastic. As the ossification advances, the mass contracts more and more, ultimately forming a firm osseous ferule, by which the fractured ends are tightly clasped; and the continuity of the bone is apparently restored. This ossified mass is termed the *provisional callus*. And the period of its formation averages from four to six weeks. At the end of this time, the bone feels firm, for the fractured ends are tightly held together by the ferule; but, in truth, they are yet disunited; there is no real continuity of their texture. 6. Continuity is truly restored by the formation of what is called the *definitive callus*. That is, exudation of an euplastic kind—chiefly furnished, it is probable, by the softened extremities of the bone—is lodged in the

interior of the fractured ends, and in the space which exists between them. The organization and ossification of this plasma—and probably its effusion also, for it is not unlikely, that a part of the original and general plasma may be absorbed, to make room for this of secondary formation—are much more slow and gradual than of that which constitutes the provisional callus; apparently in obedience to the general law, that whatever is destined for an enduring existence, is constructed leisurely and well. By the definitive callus, the ends are firmly glued together; and the fracture is truly united. In proportion as construction of the definitive callus advances, the provisional gradually diminishes by absorption; the latter being merely subservient to the former. The provisional callus, indeed, may be termed Nature's splint, whereby the parts are kept in close and undisturbed contact, until their real consolidation shall have been completed. When this has been achieved by the definitive callus, the necessity for the presence of the provisional callus has gone by, and consequently it is soon thereafter removed by the absorbents. At the same time, the absorbents are also busy with the exudation and temporary change of structure in the soft parts, restoring these nearly or altogether to their normal state; the repair in the main structure having been completed, the exterior scaffolding whereby that repair had been effected is taken away. And thus not only is the bone firmly and truly reunited, but the symmetry and usefulness of the part are also restored. This gradual change is seldom completed in less than six months; and, in some cases, even a longer period is required. 7. The definitive callus is at first preternaturally dense and compact; but is gradually modified by the absorbents; and, ultimately, is so changed as to render continuity of the normal texture of the bone complete. On making a section of recently united bone, a dense compact mass of new osseous matter is found intersecting the cancellous texture, at the site of fracture; but after a few years, section discloses that part of the bone's interior, perhaps a little more dense than elsewhere, yet open and quite of the cancellated character. And thus it would seem, that not even the definitive callus can be said to be truly permanent. On the contrary, all callus is temporary; it has a certain duty to perform; and, that having been achieved, it is taken away more or less gradually by the absorbents. When, however, the fractured ends have not been duly adjusted, but left overlapping, there is not only an unusual amount of callus thrown out, but also, a certain quantity necessarily is of a permanent nature; it being impossible, otherwise, to effect and maintain an efficient consolidation of the fracture.

Practically, it is important to remember, that the provisional callus remains to a certain extent soft and pliable, during the first few weeks of its existence; not so yielding as to admit of motion between the fractured ends, under ordinary circumstances; yet pliable enough to admit of mal-adjustment being gradually rectified, by pressure duly applied; also pliable enough to permit serious and untoward bending, if the functions of the part be too soon and too freely resumed. A broken leg must be warily used, for some considerable time after apparent consolidation; and a broken bone, any where, may have its con-

tour remedied, if need be, by suitable pressure—applied even after the process of reparation seems to have been completed.

It is obvious, that the process of repair consists of two great parts. First, the formation of the provisional callus; in other words, the construction and application of Nature's splints. Second, the substantial restoration of continuity, by the definitive callus; and the subsequent modification of the new structure. But, in some fractures, both of these parts are not present. In fracture of the neck of the femur, within the capsule, for example, there is no opportunity for the formation of provisional callus. The recipient pouch cannot be made, and there are no surrounding textures to supply the required plasma. And this is the chief reason why re-union at that part is so difficult and rare; the latter and more tedious half of the process only can be obtained. In like manner, the flat bones, more especially the cranium, have a deficiency of the provisional callus. And it is well that such is the all-wise arrangement. For, were a cranial fracture to unite, through the aid of a bulging hard matter on each aspect, the functions of the brain would assuredly be interfered with to a dangerous extent. In these bones, the re-union is by definitive callus alone; and this, if the intervening space be not great, very efficiently repairs the breach; usually at no distant period. Should, however, the hiatus between the fragments be at all considerable, the osseous reproduction is incomplete; it advances only a certain way; and the remainder of the plasma is converted into a dense ligamentous substance. This ligamentous re-union is often desirable rather than otherwise, as in the case of the patella; if the ligament be short, it is very efficient, and less liable to yield, than new bone, under re-application of violence. It may either remain ever of the ligamentous character, only increasing in density; or it may gradually become ossified, as in the case of deficiency in the cranium.

Treatment of Fracture.—This may be said to consist of three parts:—reducing the fragments to their proper position; retaining them so; and preventing re-displacement, or other evil consequences. *Reduction* is effected, without force, and gradually. With one hand, the limb is grasped on the distal aspect of the fracture, and extension made gently yet determinedly; the limb being at the same time placed in such a position, as to ensure relaxation of those muscles most likely to oppose this movement. For example, in fracture at the ankle, the leg is to be placed in a flexed posture, to relax the gastrocnemii; otherwise, much difficulty may be encountered, and the use of injurious force rendered necessary. With the other hand, counter extension and coaptating movements are made, whereby the fractured ends, which by extension have been brought to the same level, are placed in immediate and accurate contact. This constitutes reduction. The limb is then laid down gently on the bed or couch; and the hands retain this normal position of the part, until the retentive apparatus shall have been applied. At one time, it was proposed to delay reduction until the inflammatory stage had passed, leaving the part meanwhile almost unconfined, and using fomentation and poultice. But it is very obvious, that the jerking of the limb, and other movements, voluntary and in-

voluntary, to which it must be subject, will maintain and aggravate the dreaded action; and the sure way to avoid this is, to reduce at once, ere yet swelling by any kind of effusion, or spastic rigidity of the implicated muscles, have had an opportunity of opposing extension. Thus, no unnecessary and additional injury is done to the soft parts; either by continued jerking movements of the spiculated ends of the bones, in consequence of coaptation not having been effected; or by employment of force in the extension, when adjustment is at length desired. Also, the most obvious cause of continued excitement of the parts to over-action is at once removed.

Retention is effected by the fulfilment of two obvious indications. First, by keeping the limb in such a posture, as shall relax those muscles which we know to be the most busy and powerful agents of displacement. Secondly, by applying mechanical means, externally, to the fractured part; adapted to prevent motion. These mechanical appliances are termed *Splints*. They are variously constructed, but all with one object in view—to rest lightly and easily on the part, and yet be successful opponents of motion in the fragments. They may be made of iron; as the double inclined plane, so useful in most fractures of the leg. Or of wood, as the ordinary splint for fractured femur, and fractured fibula. Or of pasteboard, as in fracture of the bones of the fore-arm. Or of leather, like the splints found so useful in the chronic affections of the joints. Or of soft materials saturated with gum or starch, which become tightly adherent as well as accurately fashioned to the part. The wood, iron, and pasteboard splints are those most commonly in use, and most generally applicable. They are retained by bandaging, uniformly and evenly applied; not so slack, as to admit of any motion between the fractured ends; and not so tight, as to endanger undue pressure or constriction, either on any part or on the whole limb. The first application of the bandage should always be rather too slack than otherwise; allowance being made for the swelling and engorgement which are certain to occur, to a greater or less extent, in the course of a few hours. The splints should invariably be of sufficient length to command the neighbouring joint or joints; otherwise, by rotation, voluntary or involuntary, re-displacement will certainly be effected. In fracture of the radius, for example, unless the wrist be completely commanded, pronation—inevitably causing displacement, ill-adapted callus, and a weak as well as unseemly limb—will certainly occur. A short splint extending a little above and below the fracture only, has been well characterized by Mr. Pott, as “not only an absurdity, but a mischievous absurdity.” In order to protect the integument from being chafed by the splints, they are lined suitably; with fine tow, or cotton wadding, or soft flannel, or linen; or—especially in hospital practice—the larger splints may be furnished with small mattresses, stuffed with chaff or bran; the protecting cushion being most used, where pressure is likely to be greatest, and where chafing consequently is probable.

The splints and bandaging having been duly applied, the limb is placed in a comfortable and suitable posture—relaxation of the displacing muscles never being forgotten—and so retained. A pillow, if

need be, may be adjusted beneath the part; but the general mattress or couch, on which the patient is laid, should be rather hard than otherwise, more especially in fractures of the spine and lower extremities, in order that a tolerably uniform level may be maintained; when the double-inclined plane is used for the lower limb, this indication may be further fulfilled, by placing a flat board below the lower part of the splint. After due adjustment, the parts cannot be too little disturbed. Should the bandage become tight, from inordinate swelling of the limb, and pain be complained of; should an involuntary movement have obviously caused re-displacement; or should subsidence of the swelling, or restlessness of the patient, or both, have slackened the bandage—permitting too great a latitude of motion between the fractured ends—the retentive apparatus undoubtedly ought to be re-applied. But not unless. The “nimia diligentia” of surgery is bad in wounds; it is worse in fractures. Daily dressing, movement, and manipulation, may, in the eyes of the ignorant, express great care and anxiety, and even skill, on the part of the practitioner; but, in the minds of the well-informed, the same evidence convicts him of glaring malapraxis. It is most essential for due advancement of the process of reparation, that the uniting parts should be placed and retained in a state of absolute repose. Watchfulness and meddling are widely distinct. We cannot satisfy ourselves too often—from examination both by sight and touch, on the outside of the apparatus, and also by regard to the general state of the system—that all is advancing favourably at the site of fracture; but, at the same time, we cannot too seldom interfere with the position of the limb—when this continues accurate and easy.

An attempt has recently been made to supersede almost all other splints, by those of gun or starch; improperly. This form of splint is applied, in the same way as recommended in the treatment of chronic affections of the joints. It is of easy adaptation, looks well when applied, and is promising of much benefit; forming a tight, accurately fitting, unyielding case, in which the broken bone lies securely imbedded. Under certain circumstances, its use is in all respects admirable. But its indiscriminate employment tends manifestly to injury. During the first period of the treatment of severe fractures it is quite unsuitable; for, considerable swelling must occur, requiring proportionate slackening of retentive apparatus, which ought consequently to be light, and easily changed. Further on in the case, when the swelling has reached its acmé, and has begun to subside, it is still inappropriate; if applied to-day, the limb will have shrunk so far by to-morrow, that the apparatus has ceased to be retentive. If then employed at all, it must be almost daily renewed; and that is foreign to the nature of the application. It is only during the later periods, that its use becomes judicious. When the time for inflammatory swelling has gone by, and when further decrease of the more or less swollen limb is improbable—then, the permanent, fixed, and unyielding nature of the application ceases to be detrimental, and becomes most salutary. If used sooner, it ought not to be in mass, but after bisection; so that the apparatus then comes to resemble two neatly and closely fitting splints of the ordinary kind.

*See description of the Gun Splint, in the
5th edition of the System of Surgery*

In the case of an obstinately "rising end" of a bone, it may come to be a question, whether or not pressure should be employed, as by compress and bandaging, to force it into its normal position. In general, this question is to be answered in the negative. The pressure, unless very severe, is not likely to succeed; perhaps may fail even then; and is apt to occasion ulceration or sloughing of the integuments, or abscess more deeply seated; events all most unfavourable to the process of cure. It is better, by attention to position, to relax the muscles which are causing the displacement; and to bring the other fragment higher in its level, until a smooth and continuous re-adjustment shall have been thus attained. Most certainly, when the rising of the end is only apparent, and not real, as in the case of the clavicle, nothing can be more unwarrantable than the application of pressure to the part which is in truth undisplaced.

In most examples of fracture, extension is with propriety discontinued, so soon as the retentive apparatus have been duly applied. But, in some cases, continuance of a certain amount of extension is necessary; otherwise, by involuntary muscular action, the fragments will again be made to overlap, and the limb become shortened and deformed. In fracture of the thigh, for example, maintenance of permanent extension is, on this account, essential; and is usually effected by means of the long splint, acted on by a band attached to its upper extremity, and passed over the perineum; by the tightening of which, the splint, and the limb with which it has become as it were incorporated, are pushed steadily downwards. Or, the same indication may be fulfilled, by suspension of a weight to the distal extremity of the limb.

In some cases, no splints are required; coaptation being both effected and maintained by mere relaxation of muscles, and attention to position; as in fractures of the clavicle and patella.

Prevention is best achieved, by duly carrying out the just principles of retention; keeping the fragments rightly adjusted, preventing motion, and taking care that the bandaging is never too tight at any part of the limb. The limb, it has been stated, is to be kept in a posture favourable to muscular relaxation, and consequently conducive to the feeling of comfort. Besides, it should be placed with a view of favouring venous return, while an opposite influence is exercised towards the arterial influx; the fore-arm, for example, is slung, with the hand raised; and the lower limb is kept on the same level as the rest of the body, with the foot elevated. Undue motion, and over-action, are the great opponents of union; and either is quite sufficient to prevent it wholly. Inflammation having occurred, the exudation is aplastic, the pouch becomes that of an abscess, an opening is necessary, the case becomes compound, and cure may be indefinitely delayed. During the first few days, it is consequently our object to watch the indications of local action, and to take every precautionary means, in our power, to prevent its excessive advancement. At the first, we have contributed much towards the object in view, by gently, yet at once, effecting reduction, and maintaining it undisturbed; the main cause of over-action has thus been taken away—and that timeously. Diet is low, yet not strictly antiphlogistic, unless suspicious symptoms arise. The bowels are regu-

lated ; but purgatives are never expedient, the manifold motion which they necessarily occasion tending to much injury. In hospitals, the fracture-bed is useful, by permitting motion of the bowels without movement of the limb. If a sensation of heat, pain, and throbbing occur in the part, with restlessness, flushing of the face, and acceleration of pulse, blood may be taken from the arm, in the robust and healthy ; antimony is administered, and the diet brought down to the strictly antiphlogistic scale. And antiphlogistics will be especially active, and early, in those cases in which the fracture is in the near vicinity of important parts ; as in the case of the ribs and calvarium. If there be much involuntary spasm of the implicated muscles, jarring the fragments, opiates are useful. If the signs of local inflammatory action are distinct and advancing, notwithstanding the ordinary precautions, the retentive apparatus must be undone, and discontinued at the part ; to admit of leeches and fomentation. But this casualty is of rare occurrence, in the simple fracture, whose ordinary treatment is duly conducted. Should abscess form, it must receive the common treatment ; an early and dependent opening.

After the first eight or ten days, the risk of over-action may, under ordinary circumstances, be said to be past. Diet, accordingly, is gradually improved ; for it is essential to maintain considerable vigour in the frame, in order to obtain a due and early completion of the process of union. And this ulterior necessity should never be lost sight of, in the earlier part of the case, more especially when antiphlogistics have unfortunately become expedient.

The retentive apparatus is undone and re-applied, as seldom as possible. At each change, the condition of the fracture should be carefully observed—without movement ; more especially as regards accuracy of adjustment. If the survey prove satisfactory, the apparatus is simply re-applied as at first. If bending exist, the plints and bandaging are to be so arranged as to undo this ; gradually restoring the normal position.

At the end of the fourth or fifth week—sooner in the young and healthy, later in those of advanced years and debilitated frame—Nature's splint, the provisional callus, is complete ; and our substitutes may be discontinued. If any œdema exist, in the distal extremity of the limb—which sometimes happens, notwithstanding all our care to the contrary, more especially by uniform bandaging of every part—friction is to be employed, with continuance of the bandage. But, so soon as œdema has gone, let all bandaging be thrown aside ; otherwise atrophy and permanent debility of the limb may ensue. The joints, by friction and passive motion, are gradually brought back to their accustomed freedom of play ; and, when a joint is in the near vicinity of a fracture, it is well to practise passive motion of it very carefully, at each undoing of the retentive apparatus, that stiffness may be avoided.

Use of the part must be resumed very gradually ; more especially in the case of the lower limbs. Many a fractured leg has been set free, at the ordinary time, of the proper length, and void of all deformity, which nevertheless soon becomes both shortened and bent, to an extent

which impairs both its symmetry and function. The callus is soft and pliable at first, as has already been observed; and the motto of the convalescent should be "*Festina lente*."

Fracture with Luxation.—This is a rare complication of injuries; but sometimes occurs; as at the shoulder; the head of the humerus being displaced into the axilla, while fracture occurs at the neck of the bone. In the treatment, the dislocation should first be reduced, if possible, by coaptating manipulation; and then the fracture may be managed in the ordinary way. But, if reduction fail, then the fracture must be attended to; and, when it has become consolidated, it is quite possible that attempts to reduce the dislocation, in the usual way, by extension, may be warrantable.

Compound Fracture.—The wound which renders a fracture compound, may be made at once by the fracturing violence; or, subsequently to the fracture, by one or other of the sharp fragments protruding through the skin; or, at a more remote period, by sloughing or ulceration of the super-imposed soft parts. The most ordinary examples are those effected by either of the two first causes.

If inflammation be wholly averted, the wound closes at once, and reparation of the fracture advances in the same way as in the simple form of injury. But when inflammation has become established—as it is certain to be in almost all the cases of severity—the work of reparation is altogether delayed, until the inflammation shall have abated. The union, then, is by the second intention, as in flesh wounds. The wound of the soft parts granulates and contracts, the discharge gradually diminishing. At the same time, the bone and textures around furnish plastic matter, which, becoming organized and ossified, effects reparation in the bone; more slowly, and usually less efficiently, than when no inflammation has occurred; yet well enough to restore strength and general fulness to the part.

The surgeon's first care is to ascertain, whether any attempt ought to be made to save the limb. In the slighter cases, there is no difficulty; but, in those of severity and complication, much careful and anxious thought, tempered by reference to past experience, is required, ere a just determination can be attained. In all cases of what may be termed decided doubt, it seems but reasonable that the patient should have the benefit of that doubt; and that, therefore, adjustment and retention may be instituted immediately, with a view to a tedious yet ultimate cure. When, on the contrary, we are satisfied, both from the appearance of the parts, and from our experience of similar cases, that a cure cannot be procured with the limb retained; that amputation must be performed, sooner or later, either on account of gangrene, or in consequence of the system's yielding under the hectic or a protracted and profuse discharge; the operation should be at once performed, to anticipate all such certain evils—so soon as the shock of the injury shall have sufficiently passed away, and before the inflammatory accession shall have begun.

It is not easy to lay down definite rules for guidance in regard to such primary amputations. But the following circumstances may be

safely stated, as adverse to a favourable prognosis. Comminution of the bone, or fracture at several points; extension of the fracture into an important articulation; an open state of the joint; much bruising and laceration of the soft parts, rendering extensive sloughing inevitable, with a risk of such gangrene invading the whole limb, and with a certainty of extensive and tedious suppuration following on the separation of the sloughs; laceration of a large artery, as evidenced either by hemorrhage, or by rapid formation of a large, bloody swelling; old age; and enfeeblement of the frame by disease, privation, intemperate habits, or other cause.

When, on the other hand, circumstances are favourable, and it is determined to save the limb, if possible—reduction is to be effected, carefully, gently, immediately, and with due attention to muscular relaxation by position, as in the simple form of injury. If the fracture be oblique, and a sharp end of the bone protrude to some distance through a comparatively limited opening in the integument, some difficulty is not unlikely to be experienced in effecting the desired replacement; and a question will naturally arise, as to whether the wound is to be enlarged, or the bone abbreviated. In general, the latter alternative is the preferable; for, *cæteris paribus*, the smaller the integumental wound, the less the hazard of the compound fracture. The projecting portion, therefore, is to be removed, by the saw or bone-pliers, to the requisite extent. The bone having been accurately adjusted, our care is then directed to the integumental wound; which is brought neatly together, when at all approaching to the incised in character, and is treated for adhesion. Stitches should be avoided, if possible; the preferable retentive agent is the adhesive plaster. And, when the wound is very limited, scarcely exceeding a puncture in dimensions, the plaster should be made to cover it completely, so as wholly to exclude the atmospheric air, and so render immediate union almost certain. It is obviously a great matter, if, in the course of the first two or three days, we can succeed, by such means, in converting the compound into the simple form of injury. But, when the wound is plainly bruised, torn, or of such a form that adhesion is impossible, the water-dressing is applied in the ordinary way, as suitable for granulation; approximation being entrusted to position and the adhesive plaster; and sutures never being employed. At first, the water-dressing is cold, and kept continuously so, for the purpose of allaying and moderating the inflammatory action; and the method of irrigation is often very suitable.

Retentive apparatus is applied, in the same way as in simple fracture; but with especial care, so as to avoid both undue motion, and undue pressure, or constriction at any part. And the splints and bandages should also be so constructed and arranged, as to leave the wound capable of being readily exposed, for the purpose of inspection and dressing, without any undoing of the general apparatus. On this account, the many-tailed bandage, or a series of slips of bandage, are preferable to the common roller; at all events, in the neighbourhood of the injury. At first, the antiphlogistic regimen is more especially necessary than in simple fracture; both the likelihood and the hazard of

inflammation being more imminent. And, should over-action threaten in a decided manner, general bleeding, antimony, and the other active antiphlogistics—purgatives excepted—are to be energetically employed; unless contra-indicated by age, or other debility of system; yet, in severe cases, always with an eye to the ulterior result—the coming period of supuration and hectic.

When the bone is comminuted at the site of fracture, a question often arises as to the expediency of removing the fragments; whether they are likely to die, and so delay the cure, perhaps preventing union altogether; or whether they are likely to retain their vitality, and so both facilitate the cure, and render it more satisfactory when it has occurred. If the fragments are completely detached, they should certainly be removed at once; even now they are foreign bodies. If they are well connected, not only by periosteum, but by the surrounding soft parts, they should be carefully replaced and retained in their proper position, with a view towards consolidation. If they are connected only by periosteum, they may be still left, with good hope of re-union, in the young and healthy; but, in the old, they had better at once be taken away. If, at any time, their necrosis becomes certain, they are to receive the same treatment as dead portions of bone under ordinary circumstances; spontaneous detachment is to be patiently awaited, and then the loose sequestrum is to be lifted away. Sometimes, when the necrosis has been slight and gradual, and has occurred late in the cure, the provisional callus enacts the part of the substitute bone, and may confine the sequestrum. In this case, the definitive callus cannot form; supuration will continue, more or less profuse; the fracture cannot unite; and the whole frame is likely to give way, by hectic. Still amputation is not inevitable. Let the principles of treatment applicable to necrosis again be carried out; let the callus be divided, so as to expose the sequestrum, and admit of its removal; then re-apply the retentive apparatus, and conduct the treatment in the ordinary way.

When supuration has become established, and is of moderate character, and limited to the wound, continuance of the simple water-dressing is sufficient. When, however, it threatens to become diffuse, or abscess forms in the vicinity, free and early incision is to be had recourse to; with fomentation, and hot epithems, and especial quiet of the limb. In fact, the general principles of treatment suitable to abscess are to be enforced. No squeezing or pressure is at all warrantable, during the acute stage; if the matter cannot otherwise be prevented from undue accumulation, a dependent counter-opening must be made unhesitatingly.

Should gangrene invade, or plainly threaten to invade, the whole limb, during the inflammatory stage, amputation, immediate and high, affords the only chance of safety. Later, when the frame is plainly unable to struggle longer, with a prospect of success, against the hectic cause, amputation is also demanded. A part must be sacrificed to save the whole.

Hemorrhage is sometimes troublesome in compound fracture. It may occur at the time of the injury; an important artery having been punctured or torn. The bleeding point is to be sought for, and secured

by ligature, as in ordinary arterial bleeding; the wound being dilated, if need be. Or, it may take place during the progress of the cure, by ulceration; either during separation of the sloughs, or at a more remote period; or it may be the consequence of an invasion of the sloughing phagedæna. If such hemorrhage be trivial, evidently proceeding from a vessel of no great magnitude, it may be restrained by pressure, moderately but accurately applied. If the bleeding, on the contrary, be important, and plainly from a vessel of a high class, the restraining pressure is to be assisted by deligation of the main arterial trunk on the cardiac aspect; ligature of the femoral, for example, being practised on account of secondary hemorrhage after compound fracture below the knee. The process of cure is not necessarily delayed, or rendered imperfect, by the occurrence of such an accident. Should the deligation fail—as is not likely—amputation is the last resource; but one which, fortunately, seldom requires to be adopted.

Sometimes, in the adolescent, the existence of the epiphysis is the means of preventing compound dislocation, and determining compound fracture. For instance, when a severe wrench is sustained by the ankle, the natural tendency is probably to compound luxation of the tibia inwards; but, the bone yields at the connexion of its shaft with the epiphysis; the latter portion remains undisturbed in its place; while the lower end of the shaft, of a transverse and indented aspect, protrudes through the integument. This form of accident is termed *Dias-tasis*—and is amenable to the same treatment as compound fracture in general. In most cases, it is rather a favourable occurrence than otherwise; the patient being likely to suffer less, and to retain a more useful limb, than after a compound dislocation.

Occasionally, diastasis takes place, without wound of the soft parts. The condyles of the femur, for example, may be twisted from the shaft. The same treatment is required as for simple fracture; with, perhaps, more care in both reduction and retention.

Ununited Fracture.—A fracture may fail to unite, from various causes. 1. If motion be permitted, and still more if it be made, daily or even occasionally, the formation of provisional callus will be disturbed, and that of the definitive is likely to be altogether frustrated; the part will probably remain pliable. 2. Or the parts may be duly adjusted and retained, and re-union fail by excess of vascular action, in any way induced; inflammation being just as adverse to the process of healing in bone, as it is in the wound or ulcer of the soft parts. Necrosis, as already stated, is an insuperable obstacle, until the dead portion have been extruded. 3. From constitutional defect, or atmospheric accident, there may be a want of action in the part; plasma is deficient; and what is afforded is but imperfectly organized; just as an indolent ulcer of the leg refuses to heal. The last, however, is by much the most rare occurrence of the three.

It may happen that a portion of the soft parts—as a slip of muscle—has become lodged between the fragments; until displaced, it is plainly a mechanical obstacle to re-union. Age, also, and long-sustained ha-

bits of intemperance, are sure to delay, and sometimes may prevent the cure.

Disunited Fracture.—A fracture may have been consolidated in the ordinary way, and again become loose and moveable. This may be the result of fresh mechanical violence, occasioning immediate disruption of the connecting medium. Or it may be a more tardy but equally certain process, the result of inflammatory action; induced by a less degree of external violence, or by any other cause; just as a wound, recently united by adhesion, may be made to gape, even wider than before, by accession of inflammation, suppuration, and ulceration. Or, the disjunction may be the result of constitutional disorder, entailing a remarkable tendency to absorption of all recent structures, whether in the hard or soft tissues; as is not unfrequently exemplified by the simple disunion of fractures, on board of ship, in consequence of the invasion of scurvy.

The *false joint* which results either from disunited, or from ununited fracture, bears no true resemblance to the normal articulation. There is neither articular cartilage, nor synovial apparatus. The ends of the bone taper somewhat, and are rounded off; they are invested by a dense ligamentous expansion; and, by a similar texture, of less density, they are joined together. By such an arrangement, extent of motion is abundantly favoured and a limb, so circumstanced, is, if unsupported by extrinsic aid, almost wholly useless as an organ either of prehension or support. The occurrence is more frequent in military than in civil practice; for two very obvious reasons:—first, the means for duly conducting the treatment of fracture are less available; secondly, the bruising inflicted by shot wounds is inimical to satisfactory processes of cure, both in the soft and in the hard textures.

Treatment of False Joint.—The retentive apparatus of a fractured limb having been undone, at the usual period, and the part being found yet mobile, we are not warranted in supposing that union has altogether failed. There is evidence only of failure in the first part; the formation of the provisional callus. This is wanting, or has proved imperfect and insufficient. The definitive callus, however, may be duly advanced and in progress. The limb, therefore, is to be put up, more carefully than before; in order that our comparatively clumsy splints may atone for the want of Nature's more skilful adaptations; and in order that, immobility of the part being maintained, consolidation by the definitive callus may be duly favoured. All may advance prosperously, and the cure, though tedious, may prove firm and satisfactory.

The first mode of treatment, then, to be adopted, is the application and maintenance of retentive apparatus, as for fracture at the first; only, if possible, more carefully applied, and with the certain prospect of long retention. The starch and gum adaptations are extremely suitable. At the same time, the general health is attended to; the diet is generous and stimuli are administered, if deemed advisable, to maintain energy of system for due sustainment of local reparative action. If, however, on removal of the apparatus, after another month or six weeks have elapsed, the part be still found mobile, it is reasonable to

infer that the second part of the curative process, the formation of the definitive callus, has also failed; and steps must be taken to arouse an action, whose energy is proved to be so very deficient. It has been proposed to effect this, by rubbing the ends rudely together, and then re-applying the retentive apparatus as before; or by cutting down upon the part, sawing off the recusant ends of the bone, re-adjusting them, and treating the case as an ordinary compound fracture. The one mode of procedure is likely to fail; being insufficient for the end in view. The other is too severe; it may prove perilous to life. A preferable mode, is the use of a seton; which is inserted between the ends of the bone, and permitted to remain there, for some days, until sufficiency of plasma has been effused around, in the shape of the organizable fibrin which always attends more or less on the lodgement of such a suppurative agent. We wish for inflammation, and excite it, because it brings fibrin; and we maintain that action until a sufficient tendency to the importation of fibrin has been so established; but, when this latter object has been attained, we withdraw the cause and moderate the action, in order that the fibrin may not run to waste and be discharged as pus, but become plastic and remain, available for the purposes of repair. It is a common error to retain the seton much too long, in these and similar cases.

I am inclined to think, that the principle of subcutaneous section might be made very useful here. That a strong needle, having been passed obliquely down to the part, should have its edge freely moved about in all directions, so as to cut up the ligamentous bond of union, as well as the dense investment of the ends of the bones; the needle being then carefully withdrawn, and the puncture covered by the isinglass plaster. The parts will probably be reduced to a state very similar to what attends on ordinary fracture at the first. A pouch of blood will form; the blood will be absorbed; fibrin will take its place; inflammation being absent, the plasma will become organized, and probably form an excellent imitation of the ordinary provisional callus; while, at the same time, secretion and organization may advance from the ends of the bone; and consolidation, as by definitive callus, be completed. The needle may supersede the seton.

Should cure of the false joint fail, palliation may be obtained, and the part rendered tolerably useful, by the application of a tight, unyielding, broad belt, or ferule, at the part; an imitation, as to effect, of the provisional callus.

See Blasdel's on Great Intest. by Great Int. Am. Jour. July, 3, 1851
— on subcutaneous, production of the Bone. Ibid. 1853
— the history of the history of the bone. Ibid. 1853

CHAPTER XX.

DISLOCATION.

DISLOCATION, or luxation, denotes displacement of a joint, the bones remaining entire. Some joints are more liable than others to such injury; first, those of the ball and socket construction, as the shoulder and hip; next, the ginglymoid, as the elbow. And, again, the articulations most exposed to external violence are necessarily the most liable to displacement.

The *causes* are, first, Predisposing. Peculiarity of construction and site, as just stated, may be said to be of this class. Also, weakness of surrounding muscles plainly favours the occurrence. The muscles afford much support, even in the dead body, to the joints; and any articulation, which lacks that accustomed aid, will be especially liable to dislocation. The joints of atrophied and paralyzed limbs, consequently, are in especial danger. Undue elongation of the proper articulating apparatus also predisposes; whether this be the result of external violence—as in the case of over-extension—or of chronic disease. Accumulation of fluid in a joint predisposes, particularly in those of ball and socket construction; inasmuch as that effect of atmospheric pressure is thereby interfered with, by which the articulating ends are kept in apposition. Destructive disease of joints manifestly tends to their displacement, as formerly stated; but a slight force is sufficient, when the retentive structure has almost all fallen before ulceration. One dislocation predisposes to another. A joint, once luxated, is especially liable to redisplacement; for, the muscles have been weakened, the articulating apparatus has been stretched and elongated; and the latter, too, may be yet deficient at the part where the end of the bone escaped.

The *Exciting causes* are, like those of fracture, external violence and muscular action. A blow or fall, as was stated, may occasion fracture, applied either directly or indirectly; most frequently, the break is from direct violence. Dislocation, in like manner, may be produced either directly or indirectly; but is most likely to occur, when the force is indirect—applied at the end of a long bone, and operating indirectly on its farther extremity. Thus, a patient, falling directly on the shoulder or hip, is most apt to suffer fracture. Whereas, when he falls on the hand or foot, knee or elbow, and the injury is sustained at the hip or shoulder, it is much more likely to be dislocation. The muscles surrounding the joint, were they on application of the violence to act all at once, in unison, would doubtless support the part, and oppose the displacing agency. But, one or two, acting with suddenness and

energy, will plainly tend rather to favour the occurrence of dislodgement, as well as to determine the direction in which it is to take place. Muscular action, alone, may effect the luxation; as in the case of the lower jaw; also in those cases in which there is much laxity and elongation of the articulating apparatus, and in which, consequently, the patient may have almost a voluntary power in effecting displacement.

When the accident results from muscular action alone, or in consequence of relaxation of the ligamentous apparatus, there is seldom, if ever, any laceration of muscle, ligament, or tendon. But when it is produced by external violence, sudden and severe, operating on a part previously in a normal state, there is usually a giving way, by laceration, of the capsular ligament, and of muscular fibres exterior to it—those which may happen especially to oppose the displacement; tendon, too, may be either ruptured, or torn away from its osseous insertion. Such disruption of the parts exterior to the joint, doubtless, aggravates the nature of the injury, and favours extensive displacement; but, at the same time, fortunately, reduction is by the same circumstances facilitated.

Dislocation may be congenital, occurring in utero, in consequence of a rigidity of some of the muscles; in the same way as club-foot, or other mal-formations, are congenitally produced.

The *Symptoms* of dislocation are:—signs of displacement, more or less obvious; a swelling where none should be, or a hollow where the surface should be even or raised; shortening or elongation of the limb, as the case may be—more frequently the former. Much pain is complained of, particularly if a nervous trunk or plexus be compressed by the head of the bone, as in dislocation of the humerus into the axilla; and, usually, the patient is found, immediately after the accident, labouring under a marked shock or depression, often severe. Motion is very much impaired. The patient cannot raise or move the part, neither can the surgeon; and any attempt to do so, on the part of either, is attended with great increase of suffering. The part is locked and fixed; most especially after some hours have elapsed. At first, the peculiar immobility may not be very distinct, in consequence of the muscular relaxation attendant on the shock of the injury—particularly if the patient happen to be by no means of a robust and muscular frame; but, when the state of depression has passed away, spastic rigidity seizes on the muscles implicated in the hurt; and, by them, the bone, or bones, are locked firmly in their new and unnatural situation. There is swelling, as in fracture; at first, from bone being where no bone should be; subsequently, from more or less sanguineous infiltration, or accumulation; and more remotely, from the effusion which attends on aroused vascular action. On attempting motion, the bones are found entire in their continuity, the head moving obediently with the shaft. No crepitus is felt; but there may be a simulation—of a soft, sloppy, oozy character—wholly distinct from the dry, rough, crepitus of fracture, and never to be mistaken by an experienced hand or ear. Sometimes, there is an obscure and true crepitus on the surface of the part; from movement of the osseous scales which may have

been torn off the muscular or tendinous insertions. Nerves may be compressed or torn across; and numbness, or complete paralysis, will ensue. Compression is more frequent than laceration, and consequently temporary numbness is more common than complete paralysis. A certain nervous branch may be torn, while the principal nervous trunks are but temporarily inconvenienced; and, while the limb generally may recover its nervous influence, immediately on reduction, one part may remain deficient, either for a time or permanently. Thus, in dislocation of the shoulder, the circumflex nerve is apt to be seriously injured, causing paralysis of the deltoid.

On simple extension being made, the proper length of the limb is not restored, as in fracture; this is only effected by energetic extension, producing reduction; and, when effected, the limb remains of its due proportions; there is no reproduction of displacement, by muscular action, on mere cessation of extension, as in fracture. Usually, also, there is an obvious change of relative position; affecting not only the part, but the whole limb. In the common dislocation of the hip, for example, not only is the trochanter major changed from its normal relative position, but also the toes and limb are turned remarkably inwards. And this change of relative position cannot be altered, by gentle manipulation, as in fracture; but only after reduction; and, then, the restoration is permanent.

It is obviously of the highest importance, that in suspected luxation, our diagnosis should be prompt and accurate. An immediate and careful, determined, yet gentle, examination, is therefore to be made; if possible, before either the inflammatory or bloody swelling has ensued. The sooner we determine on the nature of the accident, and the sooner the suitable treatment for reduction is adopted, thereafter—when satisfied of the existence of luxation—the better it is for both the patient and the surgeon. The longer the period which elapses between infliction of the injury and the attempts at reduction, the greater are the difficulties and dangers which are to be encountered.

Dislocations of the hip may be simulated by morbus coxarius; but an inquiry into the history of the case, will sufficiently guard the practitioner against error. It is between fracture and dislocation that we are likely to be most in doubt. And it may be well here to repeat, shortly, the leading points of distinction. In dislocation, there is no true crepitus; motion, both voluntary and involuntary, is limited; the bone may be traced, entire, throughout its whole extent; simple extension will not restore due length to the limb; change of relative position is distinct, and, like the shortening of the limb, cannot be altered aright until reduction has been effected—and, then, the alteration is permanent; the application of the displacing force is usually indirect. Also, it is not unimportant to remember, that fracture is most common at an advanced age, while dislocations are seldom found but in the adolescent and adult, and most frequently in the latter.

Occasionally, dislocation is complicated with fracture. The fibula is usually broken in dislocation of the tibia; in dislocation of the hip, the acetabulum may be either chipped, or broken through; in dislocation of the elbow, the coronoid process of the ulna may be detached. And

examination of the injury should always be conducted, with a view to the possibility of this occurrence. For, if fracture co-exist, the retentive means must be much more carefully adjusted and maintained, than in simple dislocation.

The consequences of dislocation are important. The muscles—at first relaxed, during continuance of the shock of the injury—become rigid in a few hours; and, if unopposed, tend to increase still further the displacement, as in fracture. After a time, they accommodate themselves to their new relative position. If stretched by the displacement, they become permanently elongated: if relaxed, at first, they become actually shortened, and condensed in bulk. If a muscle or tendon have been detached from its origin or insertion, it becomes fixed anew, by plastic deposit. If muscular fibre have been torn, the space is filled by an adventitious structure of ligamentous appearance and density; for some time more bulky than the vacancy which it is intended to occupy. The rent in the capsular ligament, as well as that in the exterior fibrous apparatus, becomes closed by plastic exudation—also, in the first instance, usually exuberant. A new cavity of reception begins to be formed for the displaced bone. If it rest on muscle, this becomes dense, ligamentous, smooth, and lubricated; hollowed, of a suitable form, for the play of the bone. If it rest on bone, a cavity is formed there for its reception and play, partly by interstitial absorption, partly by new deposit around; and the surface of this new acetabulum, or glenoid cavity—as the case may be—becomes invested by dense ligamentous structure, well lubricated, which forms an excellent imitation, both in appearance and in function, of the normal articular cartilage. Not unfrequently, porcellaneous deposit takes the place of the lining investment. The displaced head of the bone, too, itself undergoes alteration; parting with its cartilage, flattening, and suiting itself generally to its changed circumstances. At the same time, the original articulating surface now left unoccupied, begins to change; but the change is slow and long deferred, as if effected by a reluctant hand. As if Nature were unwilling to consider restoration hopeless; and were desirous to maintain an opportunity of return, to the latest possible period. After many months, nay after years of vacancy, the glenoid cavity has been found in such a state of efficiency, and so little altered from its original structure and dimension, as to admit of replacement, and complete restoration of function; without any long time being required for re-establishment of the former freedom and extent of motion. In a macerated pelvis, evidently obtained from a patient who had lived long after the occurrence of dislocation, I have seen two acetabula in close apposition; the one original, the other of adventitious formation; and both apparently of equally efficient capabilities. After a time, however—various in different cases, yet never brief—the original articulating surface does not change materially. Its cavity is filled up, and its investing cartilage disappears; its projections are rounded off by absorption; it becomes incorporated with the surrounding soft parts; and these changes take place all the more speedily and effectually, if the new articulating surface be in its immediate vicinity, and encroach on its boundary. There seems good reason to believe, also, that the less the synovial

capsule has been injured, and the more freely it continues its secretive power, the less speedy and complete are the obliterative changes in the original structure.

Treatment.—The paramount indication is reduction, and cannot be attempted too soon. It consists of extension, to move the bone from its anormal position, and bring it on a plane with the articulating surface it has left; counter-extension, to steady the latter part, and admit of extension being satisfactorily effected; and coaptation, to replace the surfaces in apposition. If the patient be seen immediately after infliction of the injury, yet faint, with all his frame prostrate and relaxed, and incapable, by any effort, of throwing any part of his muscular system into strong resisting action, reduction may be expected to be comparatively easy. The surgeon is able to cope with the accident, single-handed. In the case of the shoulder, for example, he takes hold of the elbow with his right hand, and gently extends the arm; while, with the fingers of his left hand, he pushes the head of the bone towards the glenoid cavity. After moderate extension, he makes a sudden, combined, jerking movement; and usually succeeds.

But when hours and days have passed, the obstacles to reduction are ever on the increase. The muscles are first spasmodically rigid, and then leisurely adapt themselves to their new position; the track from the original articulating surface, through the lacerated ligamentous apparatus, is becoming more and more occupied by plastic effusion; and the displaced extremity of the bone is busy accommodating itself to the parts with which it now finds itself in contact. Sometimes the head of the bone merely projects through a narrow fissure of the capsule; and this, tightly embracing its neck, becomes agglutinated thereto by plastic exudation, and constitutes a most serious obstacle to replacement.

Such being the impediments to reduction, the indications towards its attainment become very plain; by gradual yet powerful extension, the muscular resistance must be overcome; by free rotation, and movement of the end of the bone, the new adhesions and deposits are to be broken up.

If only a few hours or days have elapsed, the extension may be entrusted to the pulling of assistants. But, when the time lapsed is considerable, it is right at once to employ mechanical aid; making extension by rope and pulleys; and so employing force with more steadiness and precision. A sudden pull and jerk may often succeed in a recent case; they never can, in one of some duration. In such, suddenness and intensity of violence are never warrantable; they are more likely to rupture muscles, arteries, or nerves, than to effect replacement of the bone. The muscular resistance is to be gradually exhausted, by constant and steady extension—determined, yet not violent; when this has been patiently effected, free movement of the end of the bone is made, to clear off adventitious hindrances; and then coaptation is attempted, as in the recent case. It is a common error, to commence attempts at coaptation, at the same time with the extension. This does harm, by stimulating the muscles to an unnecessary counteracting effort. Only after these have been exhausted by extending force, indirectly applied, should the surgeon's hand come to decided manipu-

lation of the injured part. In some cases, he may have to wait, and watchfully superintend the labour of his assistants or the pulleys, for but a few minutes; in others, his patience may be taxed for fifteen minutes, twenty, or more.

Extension by pulleys is made thus. The patient is usually recumbent, on a mattress on the floor. A broad belt is passed under the perineum, or over the chest—according as it is the upper or lower extremity that is injured—and is secured behind to some fixed point on the wall or floor; in order that thus counter extension may be sure, and the patient fixed in his place. A *laque*, or noose, is put upon the affected limb; a damp towel having been previously wrapped tightly round, to prevent excoriation. This laque usually consists of a stout band of worsted, secured on the part by what is termed the clove-hitch; the advantage of which is, that, while it holds a firm grasp, it cannot be tightened by the pulling so as unduly to constrict the limb. To the laque, the pulleys and rope are attached by a hook; the other hook is secured to a fixed point opposite the patient; and then the rope is steadily pulled, as the surgeon may direct. Instead of the laque, a circular band may be adapted to the part, and tightened by a screw; but the former is more convenient, and fully as efficient. A question may arise as to the point of its application. If attached to the distal end of the bone affected—as above the knee, in the case of dislocation of the hip—the extending force is doubtless exerted more directly, and with greater power, on the displacement; and, from bending of the leg being permitted, the desired rotatory movements of the head of the bone can be more readily and powerfully performed. Yet it may be, that the near application of the noose may have the same effect as too early attempts at coaptation, stimulating the implicated muscles to resistance of the extending power. If attached to the distal extremity of the limb, on the contrary—as above the ankle, in the example referred to—the force is indirect, and loses somewhat of its power by transmission through the intervening knee-joint; also, rotation is less easily effected; but, at the same time, an obvious advantage results, from the great length of lever which can then be employed in the movements of the head of the bone. The direction in which the extending force is to be applied, must vary according to the nature of the individual dislocation.

But the patient is not at once to be attacked by mechanical force. There are powerful auxiliary means which are invariably to be used in the first instance, in all cases where difficulty of reduction is anticipated. The less force employed, the less painful and hazardous will be the reductive efforts. We shall save the risk of rupturing muscle, artery, vein, and nerve, or of at all events injuring the parts so as to kindle an active inflammatory process in them. The muscular system may be overcome by other means than extending force; means not directed to the part, but to the whole frame. We imitate the state in which the patient is found immediately after infliction of the injury; when the opportunity is so very favourable to reduction, by reason of the prostrate and unresisting condition of the whole muscular system. The

patient is to be sickened, and temporarily enfeebled. A large bleeding from the arm will effect this; but the same object may be obtained without waste of the precious fluid; and, therefore, such other means are preferable. The patient may be put into the warm bath, and kept there till faintness ensue; or, tartar emetic may be given, in repeated doses; or tobacco may be administered—in fume, by chewing, or in the form of enema—until the desired effect has been obtained. The two first agents, being most manageable, are usually preferred.

The procedure to be followed, therefore, in cases of old standing, is:—to overcome the patient's muscular frame, either by warm bath or tartar emetic; and then to apply extending force, by pulleys, in the right direction; extension being made from the distal extremity either of the bone or of the limb, as circumstances may seem to indicate. When extension has been steadily continued for some time—the implicated muscles plainly yielding—the head of the bone becoming more loose and moveable, and approaching the plane of the articulating surface which it left—rotation is to be practised freely, in order to remove those adventitious hindrances, by deposit and adhesion, which may be in the way of replacement. And then, by coaptating movements of the surgeon's hands, the head of the bone is guided towards its normal position. The act of reduction is usually sudden; indicated sometimes by a distinct snap, but more frequently by a peculiar sensation, unattended by noise, as if a muscle, or some other part had given way. The proper length of the limb is immediately restored; and normal relative position is re-established.

So soon as the signs of reduction have occurred, the extending force is instantly desisted from. And, in obstinate cases, a sudden slackening of the extending cord—combined with a jerking, coaptating movement of the surgeon, at the joint—greatly facilitates, in truth may effect, reduction. During extension, it is well to engage the patient in a sustained conversation, insisting upon his answers; in order that he may not, by deep inspiration, make his trunk a fixed point on which muscular resistance may be raised.

In some cases, after patient extension, rotation, and coaptation, our efforts are still unsuccessful; and yet the muscles are lax and passive, the head of the bone can be moved freely, it can be brought to the plane of the deserted articulating surface—and still it refuses to enter. In the case of the acetabulum, it may be the brim of the cavity which proves the obstacle; and, by a towel placed under the thigh, the bone may be jerked or tilted over that last obstruction into its place. But, it may happen, that even this last-mentioned addition to the reductive means fails. Under such circumstances, it is plainly the formation of adhesions and new deposit which constitute the obstructing cause; and, if very free rotation have failed to overcome this, the case is undoubtedly suitable for application of the principle of subcutaneous section. A strong needle may be introduced, and moved in such a direction as to clear again an open passage towards the articulating cavity. The puncture having been carefully closed, the extending force is to be re-applied; and the coaptating means will then most probably succeed, and that readily.

In regard to old luxations, an important question arises, as to the time at which attempts at reduction cease to be warrantable. For, after a considerable period has elapsed, the new articulation becomes very serviceable, and the old has begun to be effaced; attempts at reduction, even the most strenuous, are likely to fail; and, having failed, the patient is left in a much worse plight than ever—the normal state not re-established, and the new adaptation interfered with, and arrested in its progress. Perhaps, inflammatory action may be lighted up, and abscess ensue; at all events, there is much painful swelling, the partially recovered power of motion is once more undone, and weeks or months may have again to elapse ere the part becomes so quiet and so useful, as it was before the unfortunate attempt. Some joints are more favourably situated than others in this respect. Hinge joints, as the elbow, are with difficulty reducible after three or four weeks have elapsed. On the other hand, a ball and socket joint, as the shoulder, may be practicable after almost as many months. No definite rules can be laid down. All must be left to the desire of the patient, and the judgment and experience of the surgeon. It being always remembered, that the principle of subcutaneous section, applicable to the vicinity of joints, enables us to overcome perhaps the most serious obstacles to reduction in cases of old standing; that the original articulating cavity, if not interfered with by the new formation, remains long available; and that, therefore, the period during which reduction may be attempted, is to be regarded as now considerably extended, beyond what the older authorities were willing to allow. Already, through the aid of subcutaneous section, dislocation of the humerus of two years' duration has been reduced, in all respects successfully.

In fractures, reduction is usually easy; while retention is accomplished, not without care and trouble, and often with difficulty. Such matters are reversed in dislocation. Reduction is difficult, retention easy and simple. It is sufficient to bind down the limb, gently, by bandaging, so as to prevent any movement favourable to displacement. When the patient is discreet and trustworthy, such deligation may indeed be dispensed with; except in the case of old dislocations of the shallow joints, as the shoulder; for in such only is there a tendency to re-displacement, and likelihood of its occurrence.

Prevention, too, is accomplished, without difficulty. For a day or two after reduction, the patient is kept quiet, and on low diet. The part is fomented; and, if need be, leeches are applied. Higher antiphlogistics are very seldom required. Pain and swelling having subsided, motion is to be gradually and gently restored; assisted by moderate friction. If a muscle, as the deltoid, remain weak and flaccid, its contractility may be aroused, and normal development favoured, by powerful and stimulant friction; or by the application of electro-galvanism.

Compound Dislocation.—This is dislocation with corresponding wound of the integuments; and, through this wound, the displaced bone usually projects to a greater or less extent. The ankle is most liable to this form of injury.

The same general observations apply, as to compound fracture. There is generally less bruising of the soft parts, less chance of arterial laceration, and, consequently, less likelihood of amputation being primarily demanded. The risk, by subsequent inflammation, however, is infinitely greater than in fracture. It is a rare thing, when the joint does not inflame acutely and intensely; the cartilage and bone ulcerating, much pus coming away, and the system becoming involved in the most severe general disturbance—at first intensely inflammatory, but soon verging towards the asthenic type. On this account, secondary amputation becomes not unfrequently expedient.

It having been determined to attempt the saving of the limb, removal of foreign matter first engages our attention. It is not unlikely, that the raw end of the bone has been in contact with the ground. Every particle of foreign matter must be carefully and gently wiped away. Sand, in a boot or shoe, is sufficiently troublesome; in the interior of an ankle joint, it must prove in the highest degree pernicious. Then the parts are reduced; the same preference being given to abbreviation of the bone, over enlargement of the wound, as in compound fracture. Indeed, the abbreviation often seems of much service; especially in the case of compound dislocation of the tibia, at the ankle; less tension ensues, the space for the inflammatory tumescence being considerably enlarged; and, in consequence of the comparative absence of tension, the inflammatory action proves less severe, and less destructive in its results.

Reduction having been duly effected, the wound is brought together, without sutures; and retentive means are carefully and lightly applied, as for compound fracture. Moderation of the inflammation, and prevention of other casualties, are also sought for in a similar way. In some cases, we succeed in arresting all intensity of inflammation; the part speedily recovers, and a certain degree of motion is retained. In other cases—and these constitute the majority—ankylosis results, after a tedious suppuration. Such stiffness, however, may be to a great extent atoned for, by increased play of a neighbouring joint; in the case of the ankle, for example, the tarsal motion becoming much more extensive. In other cases, as already stated, amputation is demanded, to save life.

Both compound dislocation and compound fracture are especially liable to occur to the intemperate; and, in many cases, but an apparently slight injury suffices for the infliction, more particularly of the former accident. *Delirium tremens*, consequently, is apt sadly to complicate the case; supervening within a short time after the accident, and usually determining an early and fatal issue. It is a disease with which every surgeon should be intimately acquainted, although strictly pertaining to the province of physic. Suffice it to say here, that it presents two distinct forms; the one sthenic, the other asthenic; the one occurring during the habitual and excessive indulgence in stimuli; the other occurring when the habitual stimuli have been suddenly abstracted; the one requiring bleeding and other antiphlogistics, cautiously conducted; the other requiring opium, in large doses, with

moderate continuance of the accustomed stimulus, and becoming greatly aggravated by bleeding or other depletion.

Subluxation.—By this term is meant incomplete displacement of a joint; the articulating surfaces remaining yet in partial apposition. It is not of frequent occurrence. An example is, partial displacement of the head of the humerus on the coracoid process. The injury may also occur at the ankle. But it is most frequently found at the wrist; the bones of the fore-arm—one or other, or both—being partially displaced towards the palmar aspect.

The causes, symptoms, and treatment, resemble those of dislocation; in a minor degree. Indeed, as in the case of the coracoid displacement, the manipulations which are necessary to ascertain the nature of the injury, often suffice almost for effecting replacement. The consequences are usually slight. Retention and prevention are simple and easy. Some persons have a voluntary power of effecting and reducing such partial displacements, by muscular effort; as in the jaw, thumb, and shoulder. In such, there is doubtless an unusual laxity of the articulating apparatus.

CHAPTER XXI.

OF SPRAIN, AND RUPTURE OF MUSCLE AND TENDON.

THE term *sprain*, or *strain*, denotes a stretching and partial laceration of the ligamentous apparatus of a joint, without displacement of the articulating surfaces. The pain and shock, immediately following, are often as great as in complete luxation; the former, after a time, becomes much more severe, probably in consequence of the unbroken continuity of the fibrous tissue, favouring the occurrence of great tension. Swelling is usually considerable; and is both immediate and secondary, as in other injuries; at first slight, from extravasation of blood; afterwards considerable, from serous effusion into the cavity of the joint, and infiltration, by vascular action, in the textures exterior. The injury is always serious; painful and troublesome in itself; and apt to lay the foundation of organic change in the joint, of the most confirmed character. The joints least prone to dislocation, are the most liable to sprain.

The indications of treatment are; to prevent, diminish, or remove inflammatory action; to favour absorption of what has been effused and extravasated; to restore function; and to avert the accession of organic change. The joint is to be kept in a state of absolute quietude throughout; restrained by a splint, if need be. Cold, continuously applied, is the most suitable immediate application; restraining extravasation of blood, and tending to avert inflammatory action. When inflammation, notwithstanding, does occur, the ordinary transition is to be gradually made to the warm applications; leeches are applied, and constitutional remedies exhibited, as circumstances may require. After vascular excitement has passed away, the part remaining feeble and swollen, gentle friction and pressure are to be employed, with a view to the favouring of absorption, and so restoring the parts, without and within the joint, to their pristine state. But this indication must, in all cases, be begun and continued with extreme caution, lest a premature and inordinate stimulus be applied, and perverted vascular action return. As the swelling decreases, and all uneasy sensations abate, passive motion is to be employed, with a view to restoration of function; but used with the same caution as the friction and bandaging. Should inflammatory action threaten to continue, of a chronic character, counter-irritation is to be employed, as in ordinary circumstances. For some time, moderate bandaging is continued, to afford support, especially when the part is in use. And, for long after, especial care should be taken to avert fresh injury, or any other cause likely to induce diseased action. For, the joint, notwithstanding all care in the treatment, too often remains both vitally and physically weak; liable to re-

production of the sprain, and to re-induction of perverted vascular action, from but slight causes. Our prophylactic care will naturally be most sedulous, in those who, from scrofulous habit, are especially prone to affections of the joints.

Rupture of Muscle.

The muscular fibre not unfrequently gives way, to a greater or less extent, in those of robust frame, advanced in years, and unaccustomed to muscular effort—when, by circumstances, they are called upon to make sudden and powerful exertion; as in running, leaping, dancing, or lifting a weight. The muscle most frequently injured thus, is the gastrocnemius at its lower part; where muscular fibre ends, and tendon begins. The consequences are:—sudden pain; swelling and discolouration, by extravasation of blood; increase of swelling and pain, by effusion attendant on roused vascular action; lameness; at first a chasm, at the site of injury, more or less extensive, according to the amount of laceration; afterwards, a hard swelling there, caused by the organized exudation which occupies the vacant space. At the time of the injury, the patient usually has a sensation as if struck on the part, is sensible that something has given way, and falls to the ground.

The treatment consists of rest, and antiphlogistic regimen; the limb being kept in such a position, as to relax the affected muscle, and place its severed fibres in contact. Re-union is not by reproduction of muscle, but by dense ligamentous texture. For obvious reasons, use of the limb is to be very gradually resumed.

Rupture of Tendon.

Tendon is ruptured, under the same circumstances as muscular fibre; perhaps more frequently. The part most commonly affected, is the Tendo Achillis. The symptoms and signs of the injury are similar to those of ruptured muscle, but of a major degree. The pain and swelling are greater; the sensation of the injury, and of something having yielded, is more distinct, and not unfrequently accompanied by a tolerably distinct snap, or other sound; the hiatus, at the part, is wider and more apparent; the lameness is more complete, and falling more certain.

Treatment is conducted as for ruptured muscle; if possible, with more care to prevent motion and ensure apposition, and usually for a longer period. Reparation is by plastic exudation, which is at first redundant in volume; but, becoming more and more dense, it occupies the space ultimately to no undue extent; not constituting true tendon, but of a firm, fibrous character, very similar to tendon in appearance, and well capable of discharging its assumed functions.

Tendon, when cut, re-unites in the same manner as after rupture. If the injury have been inflicted by accident, it is usually compound; the wound tends to inflame and suppurate; and the cure is likely to prove tedious, by granulation. When the division is by design, as for the cure of deformity, it is of subcutaneous character; re-union is sim-

ple, and comparatively rapid. In the latter case, it is not essential that the divided extremities should be in absolute contact; there is a power of efficient reproduction, even when a considerable space intervenes; a circumstance of much importance in modern surgery—directed to the relief of deformity.

Tendon may be simply displaced, and so give rise to pain, swelling, and want of power in the limb. The tendon of the biceps flexor cubiti, for example, may be tilted out of the bicipital groove, and rest on the minor tubercle. The accident is somewhat obscure, the change of relative position being but slight. When detected, replacement is easily effected.

CHAPTER XXII.

BRUISE.

BRUISE is caused by the forcible application of an obtuse body, and consists in more or less injury done to the interior of a part, without solution of continuity in the integument. The degree of severity varies, from the slightest contusion, to instant disorganization and death of the part. A spent cannon shot, for example, may, without breaking the skin, completely disorganize the part struck, reducing it at once to the condition of a jelly or pulp. Or, as happens frequently in contused wounds, the part may not be instantly deprived of life, but have its vitality so far weakened as readily to yield before the subsequent vascular action.

In ordinary bruise, however, there is no sloughing, either primary or secondary. The cellular tissue sustains a greater or less degree of disruption; blood is extravasated; and swelling results. Pain is felt at the time; of a dull kind, usually; but sometimes acute, when a sensitive part has been struck over resisting bone, as on the shin. After a time the pain becomes aggravated, if any considerable degree of perverted vascular action supervene. And, then too, swelling is increased, by the attendant effusion. If the action prove slight, the swelling soon begins to subside; effusion having ceased, and absorption begun. And, then, discolouration assumes the most prominent place among the signs of the injury; the superficially infiltrated blood, as it undergoes the absorbent change, causing a variation of hue—from the natural colour, somewhat heightened, to black or dark blue, thence to violet, from that to green, and afterwards to yellow. Gradually, the extravasation and effusion disappear; and the part is restored, almost, to the normal condition.

If an arterial branch have been ruptured, of considerable size, tumour forms rapidly; and is distinctly fluctuating; consisting of escaped blood, yet in the fluid state. After a time, partial coagulation takes place; the clot being arranged at the circumference of the swelling, and the fluid portion occupying the centre. It is most important that this be distinguished from acute abscess; for it requires very different treatment. There need be no difficulty. The one is immediate, the other of secondary formation; the abscess is necessarily preceded and attended by all the usual symptoms of inflammation, the other is not. The same process of decadence takes place, as in the ordinary bruise; swelling ceases; discolouration becomes marked and varied; the ex-

travasation, both solid and fluid, is absorbed; and, ultimately, the normal colour and form are both restored.

When an artery of some importance has given way, false aneurism may form, and follow the ordinary course. Or, the vessel may speedily become obliterated, at the ruptured part, as in the more ordinary case just mentioned; the extravasation then gradually disappears, in the usual way.

The *indications of treatment* in bruise are, like those in sprain, to avert inflammatory action, to promote absorption of the extravasation and effusion, and to restore function. Rest, fomentation, antiphlogistics when required; followed by friction, support, and gradual resumption of use. When the tendency to sanguineous extravasation is great and obvious, immediate and uniform pressure may be expedient, for a time, in order to restrain the accumulation. And, however great this may be, even with pain and tension of the integument, incision should never be practised, at least in the first instance. Many ounces of blood may be absorbed in a short time, leaving the part but little injured by the temporary malposition; but, should even the most careful puncture be made, even in slight cases, the atmospheric stimulus is almost certain to induce inflammatory action; profuse and unhealthy suppuration ensues; incision is then required, in earnest, to save texture; the system is untowardly involved; and the cure is both tedious and unsatisfactory. Keep the skin entire; leave the blood to Nature during the period of probable excitement; and afterwards contribute towards absorption, by friction, pressure, or other suitable stimuli. A solution of the muriate of ammonia often proves a grateful and efficient sorbefacient, in such cases.

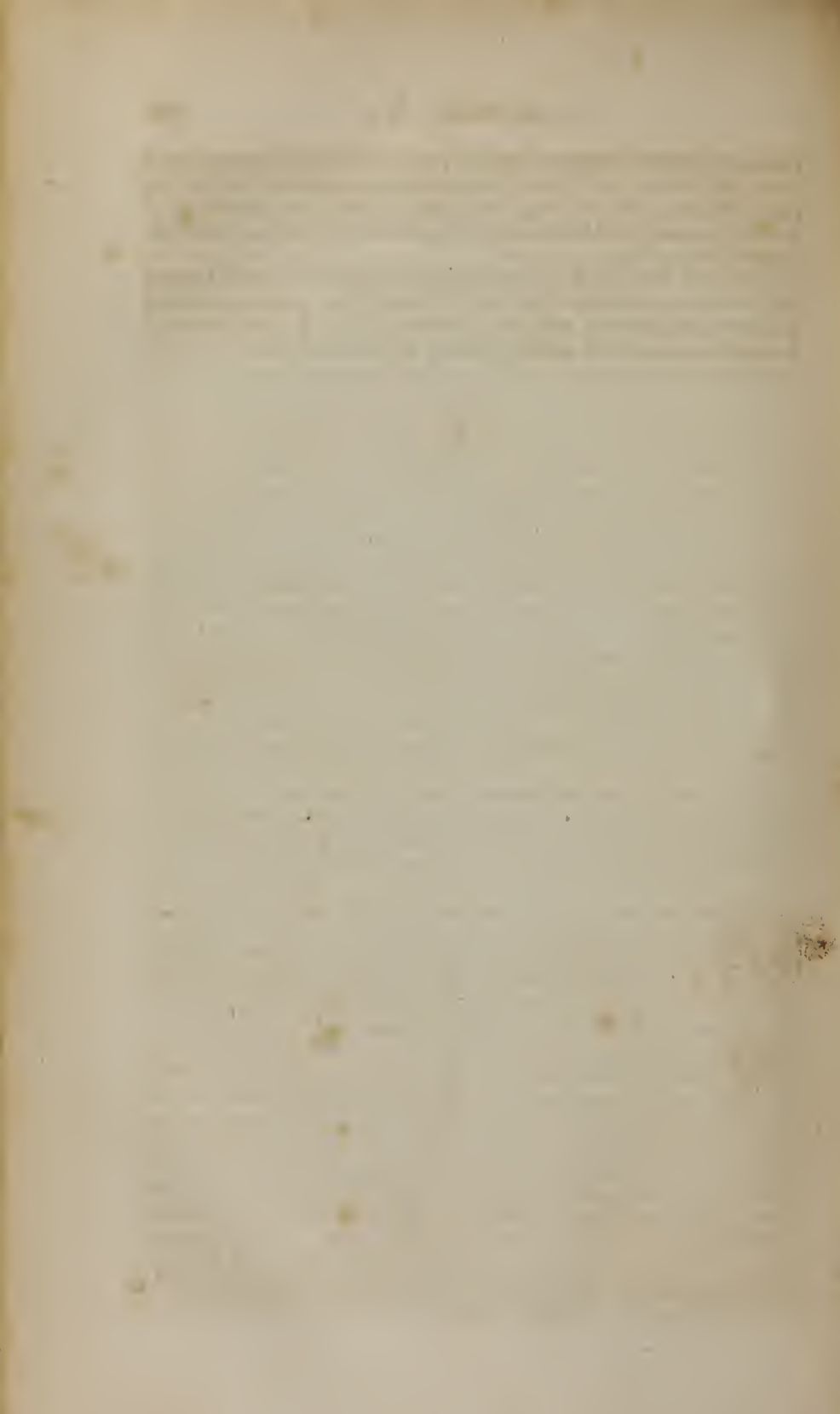
Should inflammation occur, and suppuration form in the infiltrated part, then free and early incision should be practised unhesitatingly, according to general principles. But, under all other circumstances, the knife and lancet should certainly be withheld in the treatment of a bruised part.

Two vulgar errors obtain in the treatment of sprain and bruise; the too early use of leeches and of friction. Nothing is more common than to apply leeches immediately after infliction of the injury, in order that they may suck out the extravasated, or "bruised blood," as it is called. But these little animals drink only from the running stream, drawing for themselves from the blood-vessels; and, therefore, they fail to perform what is expected of them by their employers. At the same time, their bites, admitting the external air to the extravasated blood, are likely to induce suppuration in the cellular tissue. They are of use only at a more remote period, to moderate inordinate vascular action, occurring as a secondary result of the injury. Friction, in like manner, is often employed from the first, and of a stimulating nature. The result is to induce and aggravate vascular action, an event which it ought to be our main endeavour to avoid. Friction is expedient, only after the period of excitement has passed; and, even then, it must be employed gently and with caution.

It should never be forgotten that bruise, though trifling in itself, may be most important in its remote consequences; that, as formerly ex-

plained, the plastic exudation and the perverted vascular action, which ensue, may remain, and prove the nucleus of a tumour. On this account, treatment should always be directed to complete removal of all trace of the injury; and re-accession of perverted vascular action should be especially avoided.

By the term *Ecchymosis* is understood, extravasation of blood beneath skin or mucous membrane; the result of slight bruise, or oblique wound; sometimes, unconnected with any external injury. It is amenable to the same treatment with ordinary bruise, on a reduced scale.



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

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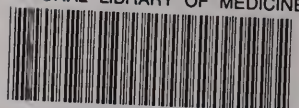
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